# AMERICAN MACHINIST

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## New Eighteen-Inch Lathe.

The engraving on this page represents an 18″ swing engine lathe, just brought out by a new machine tool-building establishment. It is designed especially to meet the growing demand of the Western and Southern trade for a tool combining all the modern appliances and improvements, and which shall be heavy, strong, accurate and durable.

This lathe swings 19″ over the ways, and 11½″ over the rest or carriage, and with a bed six feet long will turn a piece of work 2 feet 6 inches between centers. The live spindle is made of the best forged cast steel, and has a front bearing of 2¾″ diameter by 5″ in length. The boxes are made of the best charcoal cast iron (commonly known as "ordnance iron.")

The cone has 4 steps, is of large diameter and takes a 3″ wide belt.

It is turned both inside and outside to insure perfect balance. All the bearings are unusually large and long; the carriage on the ways, the tool block on the carriage, the tail base on the ways and the tail block on its base. All sliding parts are scraped to an even surface and fit (not ground with emery and oil, the usual way), and those parts subjected to bruising wear are case hardened.

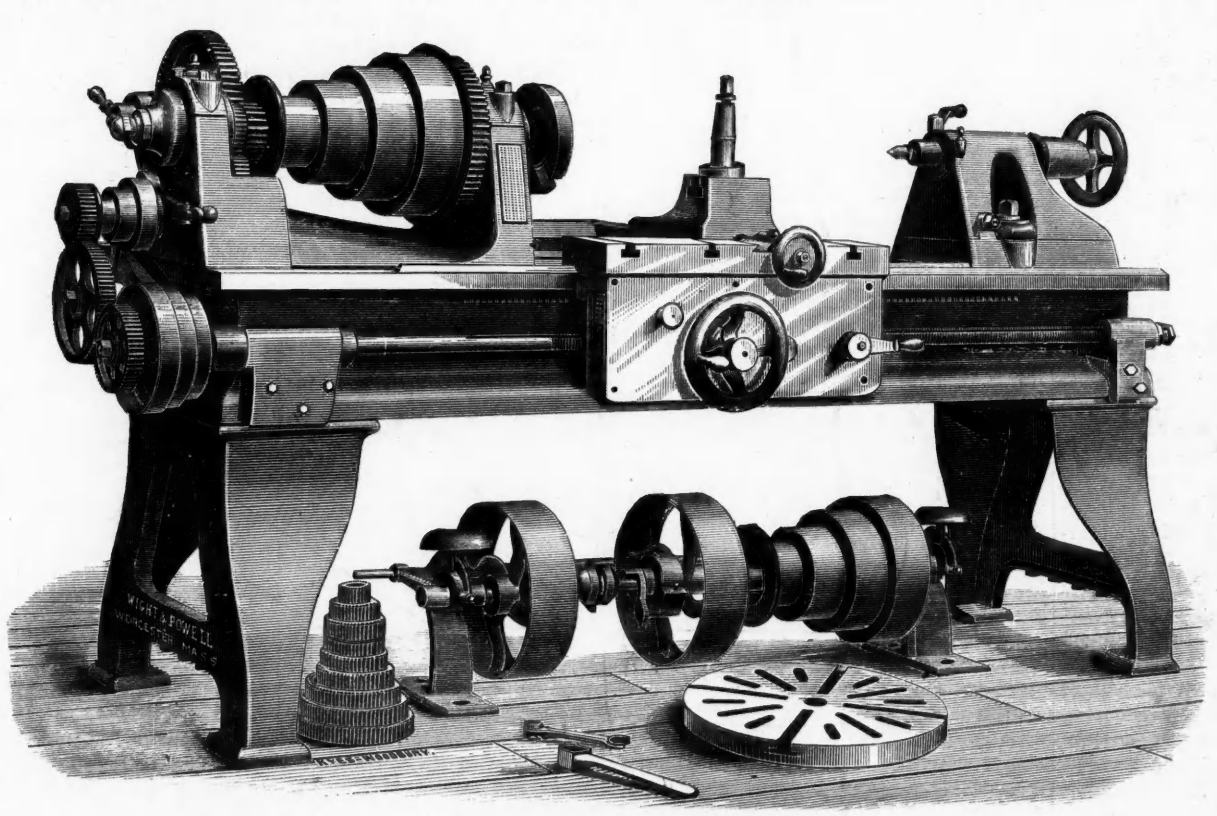
The carriage is held down by gibs, front and back. It is moved by an independent friction feed, without worm or screw, through simple gearing in the apron, to the rack on the bed. The splined screw is driven by a *cone* feed independent of the gearing, thus using the gear for screw cutting only.

The cross feed has sufficient traverse to allow squaring off the entire swing of the lathe, with only once setting the tool.

The tail stock is held down by two bolts through a gib on the under side of the ways, and has side traverse for turning tapers. The double nut is operated by a lever in front of the apron. The change feed gears are situated in the head, and are operated by a lever, the usual way. No studs are used; the change gears as well as those in the apron are mounted on steel spindles, or shafts having bearings at each end.

All spindles, screws (with the exception of the leading screw, which is made of the best iron), pinions, small screw gears, and the change feed gears are made of the best forged cast steel. T slots for the convenience of holding work for boring are put in the carriage, if so desired. Each lathe is furnished with gibbed carriage, power cross feed, plain tool block, countershaft with either patent friction pulleys, or tight and loose pulleys, center rest, screw gears, full complement of wrenches, &c.

This lathe with other sizes of similar design is made by Wight & Powell, 57 Union St., Worcester, Mass.



NEW EIGHTEEN-INCH ENGINE LATHE

## Making Shrinking Fits.

In making shrinking fits, as of wrought iron or steel in cast iron, a good practice is to allow $\frac{2}{1000}$ of an inch for each inch in diameter. The cast iron should be heated no hotter than is necessary to insure the parts going freely together, and to make sure of this a pair of inside calipers may be set enough larger than the rod or shaft to insure the necessary freedom, and the piece be heated till the expansion leaves the hole the size of the calipers. In shrinking together long fits, pains should be taken to have the "set" occur at the shoulder first; otherwise the cast iron will crawl away from the shoulder, leaving an open joint. It is a good plan when practicable to have clamps at hand to keep the joint closed while cooling. When this cannot be done, by slightly cooling the cast iron in the vicinity of the joint with a piece of wet waste, the object may be accomplished. One reason for heating as lightly as possible is that cast iron when highly heated permanently loses its size; that is, becomes larger. If too much allowance is made for shrinking it must be heated so hot that this enlargement takes place, and not only this but the "set" occurs when the iron is so hot as to give way under the pressure, and the fit, when cold, instead of being better for the increased allowance for shrinking, is materially poorer.

## Gum Joints.

In making gum (rubber) joints on the flanges of steam pipes, too little attention is usually paid to bringing the flanges fairly together. The reason for this is that it is generally possible to make such joints for the time being with the flanges considerably out of truth. This is all wrong, however, as the packing is unevenly compressed, and the strain on the pipe, incident to screwing up the joint bolts constantly, tends to loosen the packing. Joints made in this way last but a short time, and the iniquity of the individual who does the job is charged against gum packing generally.

Flanges for gum joints, while they should be turned quite true, should not be too smooth. They are much better as left by the pointed tool and reasonably coarse feed, than when finished with a smoothing tool. The flanges should come together quite fair, and the bolts, plenty in number, be screwed up evenly. After being warmed up the bolts should be tightened, which operation should be repeated once a day for three or four days.

Gum joints treated in this way—which is only reasonable—have a habit of lasting, which goes far towards redeeming them from the disgrace into which they have quite generally fallen.

## A Useful but Neglected Tool.

Apparently one of the tools the least appreciated in the average machine shop is the chuck lathe. Outside of a few large manufacturing establishments, and perhaps away from New England, the utility of this inexpensive tool is hardly considered. Work that ought to be done in a chuck lathe and with a drill is done in an engine lathe with a boring tool. An immense amount of time, in the aggregate, is lost in this way. Not only does this objection exist, but boring with an overhung tool is a severe strain on an engine lathe. The cutting edge of the tool, when boring holes of considerable depth, standing out, as it must, such a distance from the tool post, is converted into a powerful lever to strain and wear the slide, in which operation it is assisted by the intermittent action of the cutting edge, resulting from the irregularity of the surface being operated upon. The result of this is to wear the tool slide irregularly, and to develop untruthfulness for general surface turning. How often has a machinist expected to see his tool slide "let go," from the strain and jar of a long tool in a rough hole; or how often has he rigged a jury clamp to allay his fears!

Not only does a chuck lathe save time directly, but it develops a taste for uniformity of size. The flat reamer used is suggestive of a fluted reamer to scrape the holes and "make them all alike." This, in turn, makes it possible and probable that a set of mandrels will be provided, and thus the chuck lathe becomes an efficient educator.

We have been in a good many shops where a lathe of this character, run by a not particularly skilled operator, would have done the work of two or three first-class machinists, and would have increased the capacity of the shop to the extent of the same number of engine lathes, thus liberated.

The engine lathe should not be used as a chuck lathe, for the reason that such a use of it wears the tool slide out of truth, and wears the live spindle and boxes out of round, and the dead spindle loose. Besides this, it is too expensive a tool with which to do work that can be better done with a tool costing one quarter the money.

## Annealing Steel.

Annealing at a high heat is injurious. Annealing at a low heat can do no harm to steel which is to be hardened afterwards, and if applied to steel which has been heated too hot for either forging, annealing or hardening, will, to a great extent, restore such injured steel. *Heat low*, thereby keeping steel which is good all right, and making that which has been injured better.

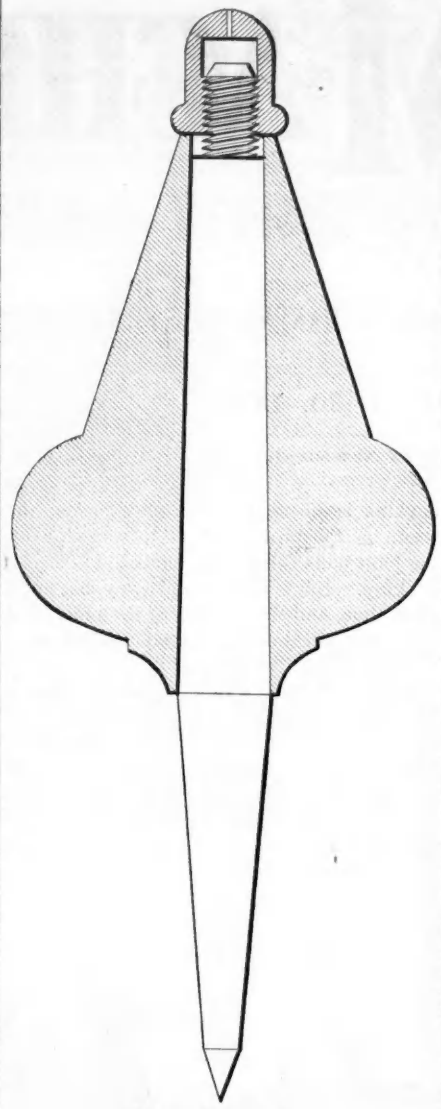
There is no "royal road" to becoming a good mechanical engineer. The genius part of the business is for the most part a humbug. Being a genius generally means having the ability and the willingness to work hard. Let no young man who has an honest liking for his vocation be discouraged at not "seeing into things" as readily as he would like to. All this will come by application and perseverence.

A fair rate for a stove foundry melting, say 20 tons a day, and using a No. 8 fan blower, is 8 tons per hour, reckoning from the time of putting on the wind till the bottom of the cupola is dropped. The number of charges is from three to five, and there is scarcely any stopping in during the melt.

### A New Plumb Bob.

The little instrument which we illustrate might perhaps with propriety be called the "Common Sense Plumb Bob," and is an evidence of the propriety of sometimes turning things the other side up; since it has, to quite an extent, the appearance of an ordinary plumb bob with the ends reversed. It is so faithfully represented as to need nothing in the way of explanation, except, perhaps, the reason for a departure from the usual form. The inventor undoubtedly appreciated the well-known fact that the stability of any body is largely dependent upon the situation of its center of gravity, with reference to its point of support or suspension. For many purposes it is important to have the point of a plum bob come to a state of rest as soon as possible, as well as to remain reasonably well fixed in that state. The inventor has, as will be noticed, placed as much of the weight as practicable considerably below the point of suspension, for the purpose of accomplishing this object.

The manner in which the steel point is fixed to the weight—passing entirely through it; the hole to receive it being reamed tapering, and being held in place by the nut through which the cord passes—makes it easy of removal for repairs or other purposes, as well as renders it a simple matter to replace the point with a new one, with a certainty of its being true with the weight. These plumb bobs are sold by S. A. Smith, 42 Dey St., New York City, and 154 Lake St., Chicago, Ill., who is the manufacturers' general agent.



A NEW PLUMB BOB.

### Moulding Elbow and Branch Pipes Without a Pattern.

BY THOMAS D. WEST.

There are often cases where a party wants a special piece of pipe in a hurry, for which he is unable to find a pattern. Almost any shaped pipe can be made, at very little expense for pattern-making, by a little extra work in the foundry. Let a clear sketch of the pipe as wanted be given to the pattern maker, from which he will make a plate pattern 1½ inches wider than the outside diameter of pipe, the extra width forming a bearing for the sweeps, *X*, which are to form the core and thickness of pipe. This pattern should have pieces nailed on where the flanges are wanted, as shown at *B B*, and an extension of five or six inches beyond all flanges for a core print. From this pattern cast two open sand plates. These cannot be counted as involving extra expense, since they would have to be made if the core was rammed in a regular core box. When all is ready, ram the core sand a little larger than the size of core wanted, and take the smallest sweep and strike off the core, following the shape of the plate when possible, and when not, as at *D*, use the trowel. When the core has been gone roughly over sprinkle it with water, and sift on core sand, using a fine sieve. After this has been packed evenly by the hands, it should be gone over evenly and steadily with the sweep, and the core slicked and finished.

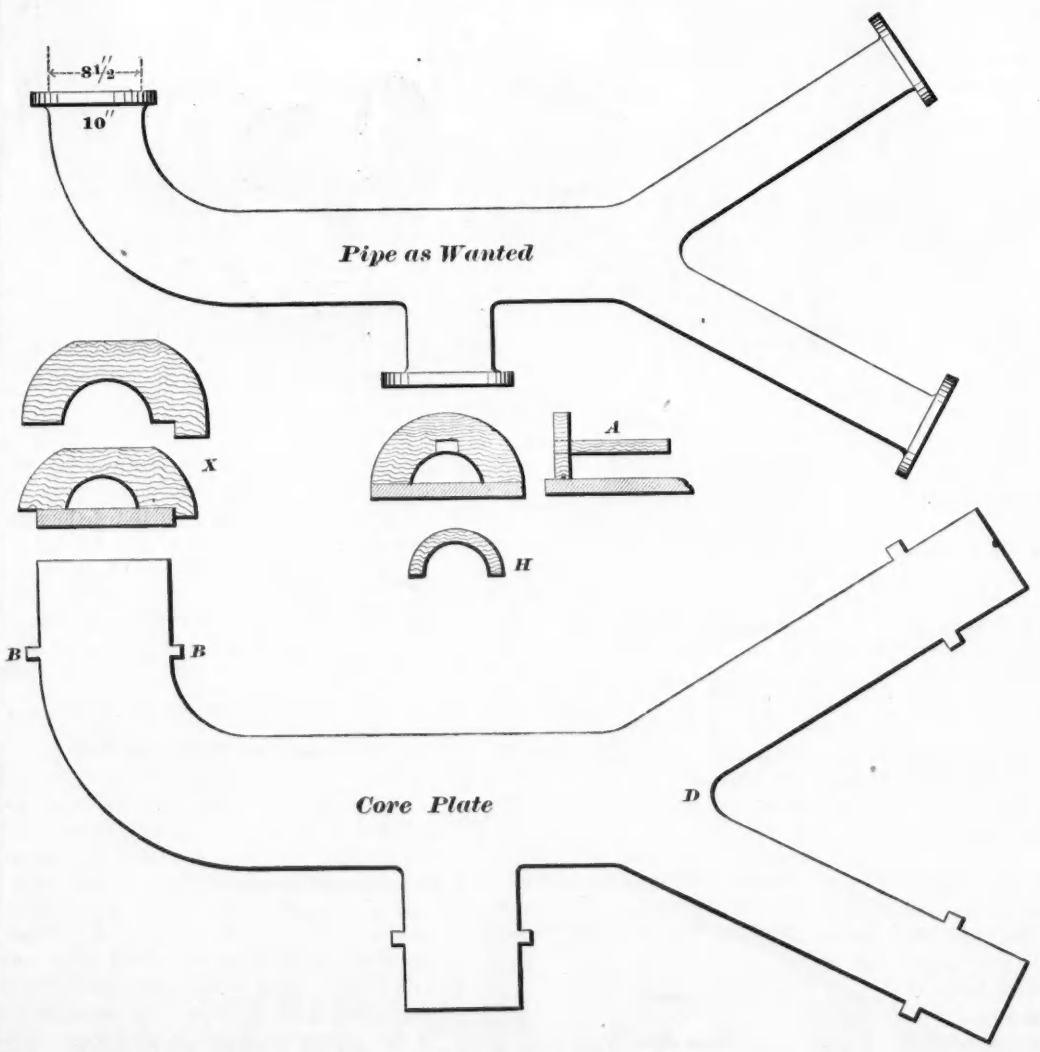
The sweeps should be made $\frac{1}{16}$ inch to $\frac{1}{8}$ inch larger than the sizes required, as the slicking will make the cores smaller.

In the bottom half of core put some nails, letting them stand out as far as possible, and have the thickness sweep clear them. These nails will help to hold the thickness on when the core is turned over. The top half of core will not need any. After the core is dried, wherever metal is wanted, rub on loam, or other mixture, that will sweep well and bake hard, and strike off with sweep to size. Have as many flanges as there are to be on the pipe turned up and cut in halves; and, to make sure of setting their faces true, it is better to have a strip of wood fastened to them, as shown at *A*, and when setting the flanges (before sweeping the thickness) drive a few nails through this strip and into the core.

The loam swept on for thickness of metal will require drying, unless the core is very hot. In using this core as a substitute for a pattern, dig a hole in the floor (that is, if you cannot get a flask to suit), bed the bottom core, set on the top half, and rub down the prints, or put sand between them, till they caliper round. The top half of the core should have hooks, so as to lift it up with the cope. When the cores are drawn knock off the thickness, paste the halves together, and let them dry while finishing the mould.

If the pipe is to be one inch or more in thickness, another plan would be to saw out a number of half-circle pieces, as shown at *H*, place them over the cores four inches or five inches apart, and when rammed and the cores drawn cut out the sand between them. This would save sweeping the thickness on the core, and in some cases might be the cheapest and the best plan.

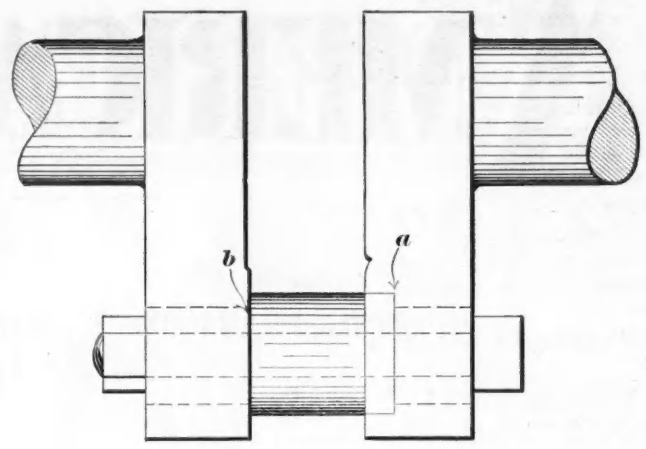
Ordinary size pipe, when time cannot be spared to cast plates, may be swept up on a wooden plate made the shape wanted, and having the flanges nailed to it to keep them in place.




### Mending a Broken Crank.

BY F. F. HEMENWAY.

Frequently, in the case of a breakdown of some important machine, the damage caused by the delay incident to its repair is of far greater consequence than the expense of the repairs. The breakdown is liable to occur just when the product of the machine is most needed, and it is often a matter of the first importance to resort to temporary means of repairs until such time as the machine can be better spared. The writer has in remembrance the instance of a broken crank pin on a 20″ saw mill engine; the break occurring about four weeks previous to the usual time of stopping for the winter, and just when the products of the mill were needed to complete orders and save loss. The crank shaft, which is shown in the engraving, was originally a solid one, but had been broken and repaired by boring out the cheeks and shrinking in a pin. This pin being in turn broken was replaced by the one as shown, in which it will be noticed that in one of the cheeks the pin is let in the full size, for about an inch, for the purpose of gaining additional strength on the end that coupled to the jack shaft. This time the pin broke at this shoulder (*a*).




The engine was situated fifty miles from any place of repairs, and the getting of the shaft out and away, repaired and back in place, would make serious inroads into the remaining four weeks. The plan suggested itself that, since there was nearly an inch of the full-sized pin in the crank, and on the driving side, a bolt entirely through the pin might possibly hold for four weeks; or, if not, that it would perhaps last long enough to get more work from the engine than would be possible in the short time that would be left after getting the crank otherwise repaired.

Accordingly a ratchet was got in place and a 2″ hole drilled through the pin, the precaution being taken to screw the binding caps firmly down to keep the shaft in line, and also to wedge the crank to keep the broken parts of the pin firmly together, so that chips would not work into the break while drilling. A reamer followed the drill, a bolt was forged at the nearest machine shop and fitted to drive hard, the engine being connected up and ready to run in about twelve hours from the time of beginning. The thing most worthy of remark is the fact that this iron bolt, which it was hoped might last four months, lasted four years. It may have been renewed once or twice in the time, a spare one being kept on hand for the purpose; but, in any event, it caused no delay, and the crank, "temporarily" repaired, lasted longer than the solid crank with two steel crank pins had collectively lasted. It lasted, in fact, till the pin broke at *b*, and the bolt, or a new one, then held it together till time to stop, in the fall.

During the winter the shaft was taken to the shop, two crank wheels cast, and the crank made up as follows: The wheels were faced, and the main eye of one and the crank pin eyes of both were bored to size. The cheek was slotted off the long end of the shaft, and the end fitted to the wheel having the main eye bored. The crank pin was turned and fitted to the wheels, and the three fits were drawn together and keyed, leaving one end of the shaft, the crank pin, and the two wheels connected In this condition they were put in the lathe, with the back rest as near the wheel as possible, and the main eye in the other wheel bored. Nothing remained to complete a true crank shaft but to fit the short end of the shaft to this eye.

The parts were drawn together with heavy bolts—no press being at hand—and the boring and turning was done with a taper of $\frac{1}{32}$″ to a foot. Although the taper part is objected to by some, the writer's experience with a good many cranks (and other things) put together in that way leads to the belief that the taper is an improvement.

Every apprentice to the machine business should adopt this as a rule: Never turn a piece of work in the lathe without drilling the centers. The practice of using good centers in a hole, as left by the prick-punch, is a relic of barbarism.

## Improved Vertical Drill Press.

One of the most desirable features in a drill press is to have sufficient stability to drill any piece of work within a reasonable limit, without springing or vibration of the column. When particularly accurate work is required, it is generally done upon an expensive boring machine, although it might be done upon a drill press properly constructed. When the spindle and column are properly supported, a drill press will bore a smooth, straight hole, as the greatest difficulty has been experienced from the tool springing away from its work when power was applied.

The drill press shown in the accompanying engraving has some new and valuable features. It will be noticed that, unlike the ordinary drill press, supported by a single column, this one has an improvement which makes what is generally the weakest part the strongest. The strength of this tool is not dependent upon a single column, nor the stiffness of the head upon a single arm. The column, which is hollow, has a web running through it. Fig. 1 represents a cross section of column and frame, while Fig. 2 shows the usual form extensively used. This web is $\frac{3}{16}$" thick, and is believed to increase the strength of the column fully one-quarter. The manner of attaching the column deserves special attention.

It has a collar at the bottom, and, being nicely fitted to the holes in the frame, is drawn up so firmly by a key at the top that it becomes as rigid as if it were cast solid with the frame.

The frame is double flanged and very stiff, hence it is not likely to vibrate when heavy work is placed upon the table. That portion of the frame where the rotary power is transmitted to the spindle is extra strong, being strengthened by the addition of an upright, connecting the upper part of the frame with the middle portion. This upright also forms a bearing for the cross shaft. In this machine the strain is distributed upon three columns instead of upon one, as has heretofore been practiced. This machine is back geared, has an adjustable friction bead which may be varied with the least possible manipulation while the machine is in motion. It is also provided with a quick-return motion and a work holder, as described in a late issue of the AMERICAN MACHINIST.

There are a number of small tools and appliances attached to this drill press, among which is a key chained to the column, for removing drills from the spindle, which prevents the workman from excusing himself for using a hammer to remove a drill because he could not find the key. The spindle is counterbalanced as shown.

Great care is exercised in executing the details of this machine, in order to give the best results. For example, all the bearings are bored large and bushed, to insure perfect alignment when renewed.

They are made with or without back gears or self feed, as desired, and in several sizes, by the Newton Machine Tool Works, 2343 Callowhill Street, Philadelphia, Pa.

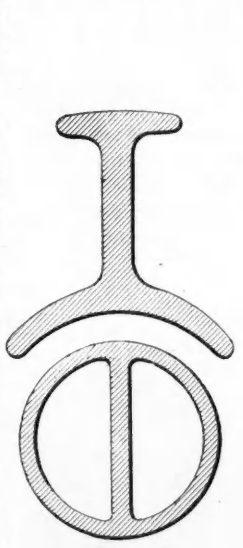


*Fig. 1.*

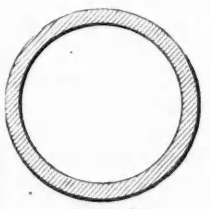
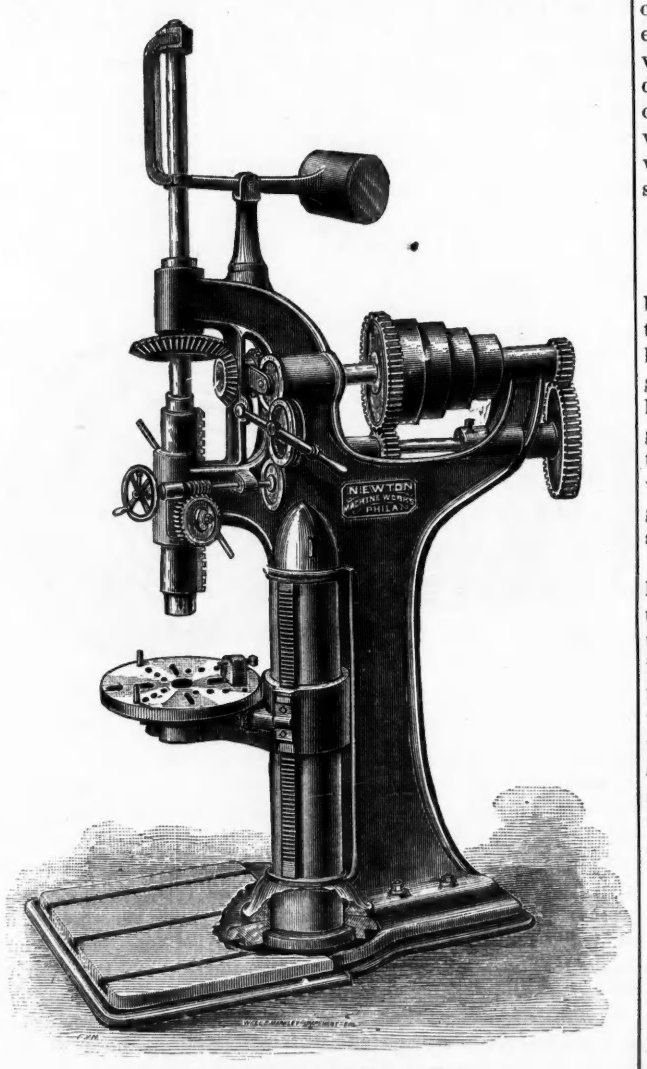


*Fig. 2.*




IMPROVED VERTICAL DRILL PRESS.

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The Chicago & Northwestern road has adopted a standard passenger locomotive, two of which have already been built, six more are in progress, and the building of ten additional ones is contemplated. Their weight in working order is 80,000 lbs. each, 52,000 of which is on the drivers; diameter of drivers 5½ feet, cylinders 17x24, boiler 50 inches diameter, with 158 two-inch flues 12 feet long; fire-boxes, 66x35. Instead of hanging the cylinders to the boiler after it is built, the smoke-arch ring is made first and taken to the erecting shop where the cylinders are hung to it, so that when the boiler comes in it can be riveted on in six hours instead of spending four or five days to hang the cylinders afterward; and it is more convenient to fit the pistons and put on the steam chests, valves and cylinder heads, with the cylinders on the floor than after they are hung to the boiler. The valves are cast at the same time in dry sand and of the same fine iron used for cylinders, thus securing a face to the valves and seats that wears longer and more evenly. Valves made of the best iron have run over 50,000 miles before re-facing, which more than compensates for the extra cost.—*National Car Builder.*

## Locomotives for Fast Passenger Trains.

The following letter from the master mechanic of the Pittsburgh, Fort Wayne & Chicago Railroad, on the subject of fast locomotives, forms part of a report of a Committee of the Railway Master Mechanics' Association, as published in the *Railway Review.*

FORT WAYNE, IND., March 17th, 1881.

*Wm. Woodcock, Esq., Chairman of Committee on the "The Best Form of Construction of Locomotives for Fast Passenger Trains."*

DEAR SIR:—The above subject is a complicated one, as in constructing a locomotive for fast passenger service, a number of conditions have to be considered: Such as the weight of trains, grades, curvature of road, distance run without stops, and kind of fuel used.

There are but few roads in this country whose passenger business will justify them in building special engines for fast trains. The business being very irregular, one day three coaches are sufficient, and on another day six or nine coaches are required, and engines must be provided to make time with any train until the limit of the power of the engine is reached.

The requisites of an engine for this business would be power, adhesion and boiler capacity; one that would start quickly and attain speed in the shortest possible time, and when running, do the work with an economical consumption of steam and fuel.

This is the problem, and I apprehend it is a more difficult one than most people have any idea of.

I do not think any special form of construction is necessary for high-speed locomotives. I believe that the ordinary American locomotive with two pairs of drivers, when properly designed and constructed, is capable of making any speed required.

Engines with a single pair of drivers have been tried, and are now used in Europe, and are effective so long as the weight of the train is below the adhesion of the drivers; as soon as it exceeds this, the wheels slip.

When the adhesion is made great enough to overcome the resistance of a heavy train, the weight on the single pair of drivers becomes too great for the strength of the rails, which are then destroyed.

There is a limit to the strength of rails, though they be made of steel. This limit is reached for 70 lb. rails, when the weight on each driver exceeds 15,000 lbs.

Of course the rail could be increased in weight and strength, but it is not likely that railroad companies would be willing to relay their lines with heavier rails to enable them to use a special engine for passenger service.

A locomotive with 17x24 inch cylinders and four drivers 5 feet or 5½ feet diameter, makes a very good class of engine for general passenger service for either fast or slow trains.

The enormous evaporation capacity of the boiler of such an engine is shown by the performance of our class "A" engine, hauling 9 cars at an average speed of 35 miles per hour. The consumption of water was 14,500 lbs. per hour; the consumption of coal was 2,900 lbs. per hour, and 160 lbs. coal burned per square foot of grate per hour.

This intense combustion and rapid evaporation is required for a 52¾ boiler to supply 17x24 inch cylinders when the engine is worked to its fullest capacity.

The theoretical weight for adhesion can be obtained with cylinders of this size, and very satisfactory results obtained.

By increasing the size of the cylinders over 17 inches the difficulty of efficient steam supply and adhesion becomes apparent.

Increasing the diameter and reducing the stroke of the cylinder is now being discussed, but I have not gone into the subject far enough to express an opinion, but it appears to me it would be an advantage.

On roads where stops are frequent, a 5-foot driver with 17"×24" cylinders will do good work.

I know there are many persons who claim that a speed of sixty miles per hour cannot be made with a 5-ft. driver and ordinary train. I also know this to be a mistake, as there is no difficulty in doing it. The piston speed is high, but it is claimed that the most effective stationary engines built are those built with high piston speed. If this is the case with a stationary engine, why should it not be equally true for a locomotive? For long-distance runs, a 5½-ft. wheel would be an advantage if the grades were low; with heavy grades, the 5-ft. wheel would give best results.

The details for a fast locomotive should be carefully worked out—large steam pipes with few turns, valves with a large cavity, and a free discharge from exhaust, should be provided. The Allen valve will be found very effective.

The boiler should be fed with injectors; pumps with an engine of this class are a constant annoyance, and time is frequently lost from their failure to work.

Large bearings with cups, to freely lubricate for the whole run, should be provided.

The parallel rods should be of steel and made as light as possible; a large per cent. of parallel rods break because they are too heavy.

Lastly, it should be borne in mind that a locomotive with a given sized cylinder, boiler pressure and weight on drivers, will have a given nnmber of tons at a given speed. When the load is greater with the same conditions, time will not be made.

The moral of this is: Do not put more cars on the train than the engine will haul and make schedule time. Yours truly,

(Signed) JAS. M. BOON, M. M.

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Mr. D. C. Jewett of Toledo, O., who has written several communications to the AMERICAN MACHINIST over the signature of "A Foundryman," which have attracted a great deal of attention, has accepted the position of superintendent of the Hartford Engineering Co's foundry. A short time ago the employes of Baker's foundry, Toledo, where he has been foreman for over a year, united in presenting him a gold-headed cane in token of their friendship and esteem.

## Nature of a Vacuum.

Considerable good-natured ridicule is leveled at shopmen for the unscientific names applied by them to tools and processes. It is an even question if they get much further out of the way than the greatest sticklers for exact expression do in their use of the word vacuum. A vacuum is a "space empty or devoid of all matter or body;" yet we read of "25 inches of vacuum" or "a ten pound vacuum," as though that were the proper way to express the condition of an empty space.

## Grinding Poppet Valves.

The engineer of one of our large river boats, who always seems fortunate in having tight valves, attributes the secret of their keeping in that condition to the fact that he grinds them but little, and never with any harsh grinding material. His plan is to grind with fine quartz till they show a seat; then wipe the valve and seat quite clean, oil with sperm or lard oil, and continue as if grinding for some hours, and until the two surfaces have a fine mirror-like appearance.

It is probable that the rubbing process hardens both valve and seat, leaving them in the best possible condition to resist the cutting action of steam across their surfaces. It is well known that valves ground with harsh, rapid-cutting material, though they may be tight at first, soon commence to leak, from the fact that the surfaces are soft and spongy as well as uneven in density. If left in this condition, the steam gets a slight start through the softer places, and soon cuts channels that destroy valve and seat.

## Areas of Circles.

One is often able mentally to compute the area of a circle by simply remembering that the area of one is to the area of another as the squares of their diameters. For instance: if we happen to remember the area of an 8" circle, it is easy to mentally calculate the area of one 1," 2," 4," 16," 32," &c. in diameter.

It generally happens that we have the areas of a few circles fixed in our memory, and from some one of these we can generally reason up to the one wanted.

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The *Iron Age*, in a late issue, gives the condition of the blast furnaces of the United States on the 1st of July, 1881, as follows:

| | In Blast. | Out of Blast. |
|---|---|---|
| Charcoal | 147 | 125 |
| Anthracite | 146 | 90 |
| Bituminous | 144 | 77 |
| Total | 437 | 292 |

This shows but little change—less than 10 per cent.—in the last six months.

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Tom and Larry were two first-class mechanics employed in one of our large manufacturing centers. Tom was given to original investigation, and, as the sequel will show, Larry was willing to assist. Tom's investigations thus far had led him to a firm belief in spontaneous combustion. Larry was skeptical; so to convince him of the correctness of his theory Tom saturated a piece of waste with certain compounds of oil, &c., and placed it in the sun to await developments. After a time Larry assisted nature with a match. Tom's triumphant entry with the waste smoking, and sympathizing friends in the secret need not be described.

## On the Ratio of Expansion of Steam at Maximum Efficiency.

BY PROF. R. H. THURSTON.

ABSTRACT OF A PAPER READ BEFORE THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS AT HARTFORD, CONN.

A paper was read by Prof. R. H. Thurston under the above title, which is too abstruse in its mathematical analysis for our readers and too long for our columns. The following is an abstract of the body of the paper and of its conclusions:

It is first shown that in every case of expansion of a working fluid like steam, air or gas, the proper ratio of expansion would be—were there no losses of work by friction, or of heat by conduction, convection or radiation—that which causes expansion to terminate at the end of stroke, with a pressure in the cylinder precisely equal to back pressure. Thus, with a pressure in the steam cylinder two pounds above a vacuum, and with the same pressure in the condenser, the end of the expansion line would meet the back-pressure line on the indicator card, and the maximum amount of work would be done with a minimum quantity of steam. With steam at 60 pounds by gauge, the expansion should be $\frac{60+15}{2}=37\frac{1}{2}$ times, and the steam should be cut off at $\frac{1}{37}$th nearly. With steam at 25 pounds, or at 100, the cut should be set at $\frac{25+15}{2}=\frac{1}{40}$th, or $\frac{100+15}{2}=\frac{1}{57}$th, or, with non-condensing engines, at $\frac{25+15}{15}=\frac{1}{2.5}$, or $\frac{100+15}{15}=\frac{1}{8}$th. Under the assumed condition, any other rates, whether greater or less, would be less economical.

But these are not the conditions under which engines are worked, and the results are absurd, as is plainly shown by the cases of the condensing engine.

All engines are subject to frictional losses, which are considerable for unloaded engines, and which become greater in absolute amount, although less as a percentage of useful effect, as the engine is more heavily loaded. This loss includes friction and resistence of pumps and attachments in condensing engines. This loss may be measured by the pressure per square inch on the piston required to overcome the total frictional resistence; and as it, like the back pressure, is a constant resistance, the expansion must be terminated whenever this source of loss produces greater loss of power than is gained by expansion beyond this point. "In fact," says the writer of the paper, "given a certain value for the sum of these resistances"—back pressure and friction—"$R=p-_b+p-_f$, it is obvious that we may consider the whole as back pressure if we choose, and that it is a matter of indifference, so far as the determination of the rate of expansion is concerned, what are their individual magnitudes."

The value of this resistance, $R=p-_b+p-_f$, may be determined by taking a friction card from the engine unloaded, and correcting it for added friction and back pressure due the load, or, better, by determining, simultaneously, the indicated and dynamometrical power of the engine, their difference being lost work, and the value of $p_s$ corresponding to that work, is that required.

"Hence, where the only variable loss is due to back pressure and to friction of engine, the rate of expansion should be such as to cause expansion to the mean pressure line of the engine diagram taken without load," nearly.

Thus, in the preceding cases, suppose the back pressure as before, but that friction of the engine is met with amounting to a maximum of two pounds, and that the friction of the exhaust steam in the ports and passages amounts to $3\frac{1}{2}$ pounds more, a total of $7\frac{1}{2}$ pounds; then we get for the ratio of expansion, which gives greatest economy of steam, in the five cases, $\frac{60+15}{7\frac{1}{2}}=\frac{1}{10}$th; $\frac{25+15}{7\frac{1}{2}}=\frac{1}{5}$th; $\frac{100+15}{7\frac{1}{2}}=\frac{1}{15}$th for the condensing engines, and $\frac{25+15}{22\frac{1}{2}}=\frac{1}{2}$; $\frac{100+15}{22\frac{1}{2}}=\frac{1}{5}$th for the non-densing engines.

But even these qualified figures are based upon inexact conditions, and the results are evidently not right, although not far from what is known by experience to be right for non-condensing engines. The writer goes on to show that, in steam engines and in most other heat engines, still another source of lost power comes in to modify the ratio of expansion, giving least expenditure of steam, and

"For steam and other vapor engines still further and still greater modification is necessary, since in such engines the departure from the ideal conditions first assumed is not only greater than in gas and air engines, but is so great as, in most cases, to lead to radically different rates of expansion. Even in the gas engines, the action of the working fluid, as assumed above, is very greatly modified by such variations from the ideal conditions as are here referred to.

"These engines—steam and vapor—are impelled by a fluid, which is a vastly better receiver and transmitter of heat than the permanent gases. Steam takes up and loses heat, in the processes of formation and of condensation, with extreme rapidity. The working fluid, in all steam engines, is readily condensible, and exchanges heat with the metallic surfaces of the working cylinder with the greatest freedom. It is usually more or less wet, and its humidity is subject to rapid and extreme variation in the course of the movement of the piston.

"Explosive and other gas engines are impelled by a mixture of hot gaseous and vaporous products of combustion, of which the latter portion is, like the working fluid in the steam and other vapor engines, subject to rapid and considerable changes of thermal state. Enclosed, usually, in a chamber the sides of which are kept cool by a water-jacket, enormous quantities of heat are lost as expansion proceeds, and the efficiency of the machine is correspondingly diminished, and the economical rate of expansion is altered by the increased losses which accompany the higher rates. It is easily seen that, should these losses increase in a high ratio, with large rates of expansion, a point will be reached, and may be reached quickly, at which any greater expansion will result in a loss exceeding in amount the work gained by the extension of the expansion line. This point may be reached, and probably often is reached, long before attaining the limit set by the value of the resistances already studied. In such a case, we may call this limit that of the *virtual back pressure due to condensation*, and may designate it as $p_c$.

"In the steam engine a still more complicated set of phenomena is to be met with, and the result of their action is similar to that just described. Suppose steam to enter the steam cylinder perfectly dry, and to expand *adiabatically*.* As expansion progresses, after the closing of the steam valve by the expansion gear, the work done by the working fluid results in the transformation of so much heat into mechanical energy—which heat can now only be obtained by drawing upon the stock contained in the steam itself—that a part of the steam becomes liquefied.

* Without receiving or losing heat by exchange with surrounding surfaces.

"This fact was shown by Rankine and by Clausius by the study of the thermodynamics of the case; but it can easily and satisfactorily be shown by any student or engineer who will take the trouble to calculate the "total heats" of steam at the pressures found at the beginning and at the end of the expansion line. It will be found that the work done during the expansion is greater than the mechanical equivalent of this difference, and it follows that a part of it must have been done at the expense of the heat of evaporation of the expanding mass. This must be the case up to a limit at which the sensible heat of steam is just equal to the latent heat of the mass when indefinitely expanded at the absolute zero, and is about $\frac{1109.5}{7.72}=1437°\pm$ absolute, a temperature only attained at the red heat.

"Steam, therefore, condenses in the steam-cylinders unless, by superheating or by the use of an efficient jacket, considerable heat is supplied it during expansion or before. This amount is, however, insignificant in comparison with direct losses of heat; it can probably never approach ten per cent. of the heat supplied, and is more likely, usually, to be a very much smaller figure, perhaps two or two and a-half per cent. for average cases. Initial condensation and later re-evaporation of steam in the steam engine, and initial condensation without subsequent re-evaporation, in gas engines, give rise to losses that are both absolutely and relatively very great wherever the range of temperature during expansion is very considerable, and especially with low back pressure.

"The steam passing out of the exhaust ports to the condenser or into the atmosphere is moist and heavy with the water of condensation, and is a good conductor of heat as well as a very greedy absorbent. It sweeps out of the cylinder large quantities of heat abstracted from the inner surfaces of the cylinder, leaving those surfaces comparatively cold and wet with a chilling dew. The entering steam meets these cold metallic and liquid masses, and is condensed in sufficient quantity to reheat them to the temperature of prime steam. As the piston moves forward it uncovers new surfaces, and condensation continues until, sometimes, a large fraction of the steam supplied lies in the cylinder or floats in the uncondensed steam as water and mist. Toward the end of expansion, and especially during exhaust, re-evaporation occurs at lower pressures and to a similarly serious extent. Thus heat is constantly transferred from the steam to the exhaust side, and, doing almost no work, is wasted, and the efficiency of the engine and the cost of fuel are greatly affected. The heat thus lost frequently amounts to 25 per cent. of the total supplied, and has been known not infrequently to amount to 50 per cent. In one case noted by the writer initial condensation was as high, *at least*, as 80 per cent.

"Since loss from this cause has been found to be so great, and to increase so rapidly with increased expansion, that it practically often sets an early limit to the economical increase of the rate of expansion, it is evident that we may determine a point such that, expansion being carried beyond it, the losses due this cause will exceed the gain of work done by the expanding fluid, precisely as in the cases already cited. Measuring the loss at such a point, we may determine the equivalent in foot-pounds of work, and thence deduce the magnitude of a new equivalent '*virtual* back pressure,' $p_v=p_c$, which, if actually existing as such pressure, would similarly limit expansion."

"In the effort to determine the value of $p_v=p_c$ for this last method of loss of efficiency, we meet with great difficulties. The loss from initial condensation and later re-evaporation is the most serious of all those losses which, in expansive engines, are in any degree due to defects of the machine as a machine, and they are among those which are controllable to a considerable extent by the engineer. No two engines, however, ever exhibit them in the same degree, and modifying conditions are so numerous and so potent that the result of the most painstaking efforts to classify and to formulate them are likely to be exceedingly unsatisfactory.

"This loss is proportionately greater as the range of temperature during expansion is greater; it is increased by slow speed of engine, by reduction of the real back pressure, by increase in size of engine for a given amount of work done, by increase in conductivity of the surfaces of the working cylinder, and especially by wetness of steam. It is reduced by low rates of expansion, by increasing back pressures, by reducing initial pressures, by increasing speed of engine and by special expedients, as steam-jacketing, superheating and the division of the expansion between two or more cylinders, as in 'compound' or double-cylinder engines. Even increasing compression may reduce this loss, and thus give a higher steam-line and an altered expansion-line.

"The waste becomes the less, when the sides of cylinders only are jacketed, the smaller their diameter; it is lessened, when both heads and sides are jacketed, by increasing diameters, volumes being in both cases equal. With superheated steam, and where there is little initial condensation to be anticipated, the shape of cylinder is determined by the minimum ratio of volume to *internal* superfices, *i. e.*, $\frac{\text{diam.}}{\text{length}}=\frac{1}{2}$, except—as is often, if not usually, the case—when it is controlled by commercial considerations. The surfaces of the piston must evidently be included, since the principal losses—those due to initial condensation and to re-evaporation—occur upon those surfaces.

"In gas engines the waste is decreased in those in which the working fluid meets only non-conducting surfaces, while it amounts as a minimum to 60 or 70 per cent. in some slow-running water-jacketed cylinders.

"Again, we find some interesting compensations. The difference in back pressure between non-condensing and condensing engines is productive of such a wide difference in the range of temperatures worked through in usual cases, that the writer has been accustomed to consider the compensation so complete as to justify the assumption that the value of *this* '*virtual* back pressure' may be assumed to be independent of the magnitude of the actual back pressure, and to be determined solely by other conditions above noted. In steam-jacketed engines the efficiency of the steam-jacket is reduced by high speed, while the losses that it is designed to check are rendered less by the reduced effect of other causes of variation of the amount of initial condensation, and, while this compensation is by no means complete, the error introduced by the assumption that it is so may perhaps be neglected in presence of so many other and such complicated causes of irregularity of action. Our approximation must be anything but close at best.

"The best that the writer has been able to do in this direction, as yet, is to make simple and roughly approximate expressions for values of $p_t=p_v$, the proper terminal pressure, which, while widely departed from in many cases, may fairly represent average practice."

Thus we may determine, in all cases, a certain "virtual back pressure" by which to identify a point beyond which continued expansion produces a loss of heat and work greater than the gain to be obtained by further expansion, and this is the real limit fixed for actual working engines.

The following tables contain the results thus deduced:

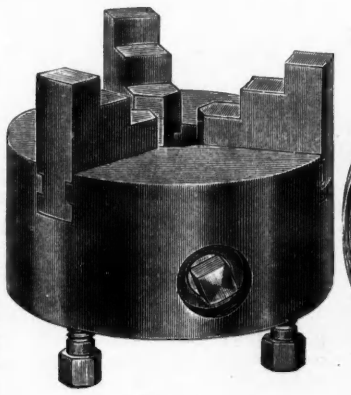


FIG. 1.

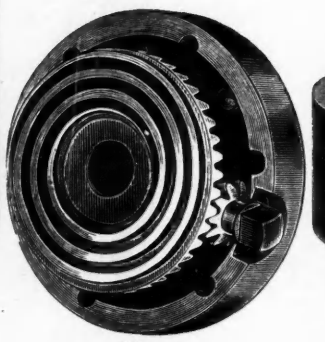


FIG. 2.

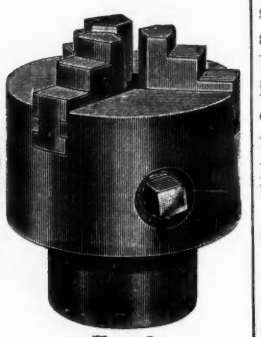


FIG. 3.

NEW LATHE AND DRILL CHUCKS.—See page 5.

I.—*Probable Terminal Pressures and Rates of Expansion at Maximum Efficiency.*

| Initial Pressures. *Absolute.* | Speed of Piston. | Single Cylinders. Non-condensing. Unjacketed. | | Non-condensing. Jacketed. | | Condensing. Unjacketed. | | Condensing. Jacketed. | | Compound ($N=2$) Condensing. Sides jacketed. | | Heads and sides jacketed. | | H'ds & sides jacketed with effic'nt super-heat'g | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | $p_t=p_v$ | $r_e$ | $p_t=p_v$ | $r_e$ | $p_t=p_v=p_c$ | $r_e$ | $p_t=p_v=p_c$ | $r_e$ | $p_t=p_v=p_e$ | $r_e$ | $p_t=p_v=p_c$ | $r_e$ | $p_t=p_v=p_b+p_f$ | $r_e$ |
| $P_1$ | $V$ | Lbs. on sq. inch. | | Lbs. on sq. inch. | | Lbs. on sq. inch. | | Lbs. on sq. inch. | | Lbs. on sq. inch. | | Lbs. on sq. inch. | | Lbs. on sq. inch. | |
| 40 | 400 | 20 | 2.0 | 20 | 2.0 | 16 | 2 5 | 13 | 3.0 | 9 | 4.5 | 7 | 6 | 7½ | 5 |
| | 625 | 20 | 2.0 | 20 | 2.0 | 13 | 3.0 | 13 | 3.0 | 9 | 4.5 | 7 | 6 | 7½ | 5 |
| 60 | 400 | 20 | 3.0 | 20 | 3.0 | 20 | 3.0 | 15 | 4.0 | 11 | 5.5 | 8 | 7.5 | 7½ | 8 |
| | 625 | 20 | 3.0 | 20 | 3.0 | 15 | 4.0 | 15 | 4.0 | 11 | 5.5 | 8 | 7.5 | 7½ | 8 |
| 80 | 400 | 23 | 3.5 | 20 | 4.0 | 23 | 3.5 | 18 | 4.5 | 13 | 6.5 | 9 | 9 | 7½ | 11 |
| | 625 | 20 | 4.0 | 20 | 4.0 | 18 | 4.5 | 18 | 4.5 | 13 | 6.5 | 9 | 9 | 7½ | 11 |
| 100 | 400 | 25 | 4.0 | 20 | 5.0 | 25 | 4 | 20 | 5.0 | 14 | 7.0 | 10 | 10 | 7½ | 13 |
| | 625 | 20 | 5.0 | 20 | 5.0 | 20 | 5 | 20 | 5.0 | 14 | 7.0 | 10 | 10 | 7½ | 13 |
| 120 | 400 | 27 | 4.5 | 22 | 5.5 | 27 | 4 5 | 22 | 5.5 | 16 | 7.5 | 11 | 10.5 | 7½ | 17 |
| | 625 | 22 | 5.5 | 22 | 5.5 | 22 | 5.5 | 22 | 5.5 | 16 | 7.5 | 11 | 10.5 | 7½ | 17 |
| 150 | 400 | 30 | 5.0 | 25 | 6 | 30 | 5.0 | 25 | 6.0 | 18 | 8.5 | 12.5 | 12 | 7½ | 20 |
| | 625 | 25 | 6.0 | 25 | 6 | 25 | 6.0 | 25 | 6 0 | 18 | 8.5 | 12.5 | 12 | 7½ | 20 |
| 200 | 400 | 36 | 5.5 | 29 | 7 | 36 | 5.5 | 29 | 7.0 | 20 | 10 0 | 14 | 14 | 7½ | 27 |
| | 625 | 29 | 7.0 | 29 | 7 | 29 | 7.0 | 29 | 7.0 | 20 | 10.0 | 14 | 14 | 7½ | 27 |

$p_t=p_v$ is taken as equal to $p_c$ except where $p_v=p_b+p_f$ exceeds $p_c$, when this greater value is adopted; *e. g.*, in non-condensing engines with low steam, and in highly superheated steam engines. $r_e$ is the ratio of expansion at maximum efficiency.

Deduct 14.7 lbs. per sq. in. to obtain gauge pressures. Hyperbolic expansion is assumed.

II.—*Probable Minimum Weights of Steam per Hour per Horse-power.*

| Best Expansion. $r_e$ | $W$ Pounds. | Best Expansion. $r_e$ | $W$ Pounds. | Best Expansion. $r_e$ | $W$ Pounds. |
|---|---|---|---|---|---|
| 3 | 32 | 8 | 20 | 13 | 19 |
| 4 | 27 | 9 | 19 | 14 | 16 |
| 5 | 25 | 10 | 19 | 16 | 16 |
| 6 | 22 | 11 | 18 | 20 | 15 |
| 7 | 20 | 12 | 17 | 25 | 15 |

III.—*Probable Minimum Weights of Coal per Horse-power per Hour.*

| Best Expansion. $r_e$ | $W'$ Pounds. | Best Expansion. $r_e$ | $W'$ Pounds. | Best Expansion. $r_e$ | $W'$ Pounds. |
|---|---|---|---|---|---|
| 3 | 3.5 | 8 | 2.2 | 13 | 1.8 |
| 4 | 3.0 | 9 | 2.1 | 14 | 1.8 |
| 5 | 2.8 | 10 | 2 1 | 16 | 1.8 |
| 6 | 2.3 | 11 | 2.0 | 20 | 1.7 |
| 7 | 2.2 | 12 | 1.9 | 25 | 1.7 |

Prof. Thurston considers these methods and values fairly satisfactory in estimating probable results in designing engines, although we often find engines working less efficiently, and, once in a while, doing somewhat better.

The formulas given are only claimed to be useful because of their simplicity; and their empirical character, while, depriving them of scientific value to a certain extent, makes them the more probably satisfactory in daily practice. The engineer, however, as is remarked, "will look with interest for experimentally derived data and exact expressions that may replace approximate formulas, which, as here provisionally used, are purely empirical, and have no scientific value."

In the paper, and in the debate which followed its presentation, it was stated that the commercial question—which is quite independent of that here considered—how far "these high efficiencies are worth paying for," is of great importance, and that it may sometimes be found that a ratio of expansion, giving comparatively low efficiency and considerable cost of power in steam and fuel, may, when all matters of cost are considered, prove on the whole most economical in dollars and cents.

## New Lathe and Drill Chucks.

We present on page 4 engravings of a new chuck, made in a special manner. Fig. 1 represents the chuck complete, in which the metal is evenly distributed, so as to insure the requisite strength without clumsiness. An internal view of this chuck—of the scroll gear and pinion—is shown in Fig. 2. All the working parts are made of the best machinery steel, cut from the solid bar. By this course a superior quality of work is produced which possesses great durability. The fronts of the 2″ and 3″ chucks are made of malleable iron to avoid any possibility of cracking. The backs are of cast iron. In these sizes the points of the face are not joined together as in the larger sizes, the hub which the scroll is fitted to being on the back instead of on the front as in the larger ones. The scroll is made from a bar of machinery steel cut suitable to fit the lathe. It is then drilled into the end, and cut off the requisite thickness. The scroll is cut, then fitted to the back. This is a great improvement over the old cast steel scroll, it being much stiffer and stronger, and will not wear as quickly, thus keeping the chuck true much longer. In all the standard geared scroll chucks of this style the back is screwed firmly to the front, making it very solid and firm. The jaws are turned with the back-lash all taken out, making them equally true in all places. The wrenches are of best Norway iron. The end to be punched is first welded up, drilled, and then punched. After the wrench is turned up and finished, it is case hardened and polished.

Special shaped jaws, or the addition of one extra to the regular number, or chucks with three pinions, are supplied when desired. The necessary bolts and wrench are furnished with each chuck.

Fig. 3 represents a drill chuck. The 2″ chuck is fitted to the lathe upon a plug center. The 3″ chuck can be used either upon a plug or face plate, which is a decided advantage in some classes of work. In the manufacture of these chucks the greatest care is taken to produce the parts so as to interchange and to operate as perfectly as if each part was fitted to its respective place. The machinery used is entirely new and made with special reference to the manufacture of these chucks. They are furnished by James D. Foot, sole agent, 101 Chambers St., New York City.

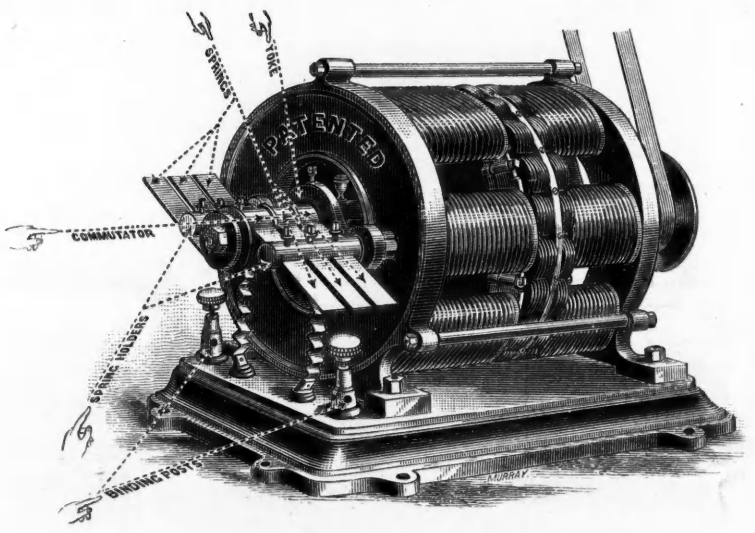
During the month of June, 39 locomotives were exported through New York City.

## Improved Dynamo-Electric Machine.

Many people object to the electric light on account of the expense of a necessary plant. Their premises, being small, would require one or, perhaps, two electric lights; therefore it would be neither wise nor economical to purchase a large, expensive machine, and use only a small portion of the electrical force developed.

The Brady Manufacturing Company, 257 and 259 Water street, Brooklyn, N. Y., are now building a machine to meet the wants of such people. It is a small dynamo-electric machine, represented by the accompanying engraving, and occupies a floor space 11″ × 11″ × 16″, and weighs 85 lbs.

The power required to drive the machine is 1½ horse power, using a belt 1¼″ wide. This machine is intended to run one lamp only, which gives a powerful light, equal to 2,500 candle power, or, in other words, will light a space 200 feet square so that ordinary print may easily be read in any position within the space named. This machine has 18 bar magnets upon the armature, and 12 field magnets in the field. A remarkable thing about this machine is the fact that there is no outward effect from magnetism.




IMPROVED DYNAMO-ELECTRIC MACHINE.

Watches are safe from being injured by magnetism, even should they be in actual contact with the machine, and it may be placed in localities where some other dynamo machines could not be used, on account of their magnetic influences.

It is claimed that nearly all the power put into this machine is returned in the shape of light, as very little is lost through friction, and none through excess of magnetism, every particle of which is utilized. The machine is so made that any part may be removed without dissecting the machine. For instance, each or all of the bar magnets can be removed without disturbing any other part. The armature is well ventilated, so that there is no danger of the parts getting hot. All the parts are readily accessible for inspection or repairs. They are also made interchangeable. The standard gauge and jig system is used in the construction of these machines, consequently large numbers of pieces are kept in stock and will fit any machine. The lamp used with this machine is very simple, is sent out with the machine ready to use, and regulates itself.

All the attention required is to replace the carbons when burned out, and keep the parts of the lamp and machine clean—cleanliness being next to godliness in electric lighting as in other things. No knowledge of electricity is required to run this machine and light, the few simple directions accompanying each machine and lamp being all that is sufficient.

This apparatus is largely used in foundries, machine shops, pleasure grounds, etc., also by photographers, as it is furnished at a very nominal cost, and by its use prints can be taken as readily as by sunlight.

The city of Chicago has decided to contract for two more pumping engines, each with a capacity of 15,000,000 gallons, in 24 hours, and to cost $275,000.

## LETTERS FROM PRACTICAL MEN.

### Progress Towards Securing Standard Gauges.

*Editor American Machinist:*

I am pleased to see in your paper of July 2nd the report of the Master Car Builders' Committee, relating to the standard system of screw threads. The report of Mr. Ortton to the same society in 1879 was so suggestive and thorough that it should be in the possession of all mechanics, as not only the railroads but all mechanical constructors have an interest in the perfection of this system.

As there will be something of a history in connection with the adoption of this or any other complete system of screw gauges, the facts should be presented. I feel the committee would excuse or be thankful for the correction of the minor error of their report at Providence. The man Fox, spoken of as belonging to the city of New York, was the first man who had enough confidence in the general use of this system to found a manufactory of bolts and nuts based on it. He was the founder of the Boston Nut Co., at Boston. From the gauges constructed by him sixteen sets were made for the government. I have inspected three sets, two owned by the government and the other by the Morse Twist Drill and Machine Co., and as the most variation from Whitworth's standard was less than .001″ I conclude the work was creditably done, particularly as the several sets interchange. There is no question that the gauges of Pratt & Whitney were accurate, but the angle measurement of the threads is a matter of so much difficulty that these two sets of gauges will not interchange. We have mutually concluded that the best way is to commence at the foundation and have gauges about which there can be no dispute; I congratulate, not alone the railroad interests, but all interests, that the undertaking is in so competent hands. The importance of being correct impressed itself on the Pratt & Whitney Co., to the extent that machinery, costing thousands of dollars, has been completed by which to measure and construct the standards. GEO. R. STETSON.

Supt. Morse Twist Drill & Machine Co.,
New Bedford, Mass.

### Annealing Steel—A Lathe-Dog Plan.

*Editor American Machinist:*

I read in a late issue the very interesting article entitled "Hints on Working Steel," and would also add my voice in appealing for more knowledge in handling that rather mysterious metal.

My experience is that any good standard steel will work about the same when annealed under the same or like conditions (mechanically). I get very good results by cutting steel to the sizes required, placing them in a cast iron pot or crucible, filling in with sand, ashes, or charcoal, fastening on the cover, and luting it with clay, putting it in a furnace and heating for about ten hours, banking up the fire so that it will not cool for about 48 hours, after which process I can cut the steel very easily with a pocket knife.

I once tried this plan with a lot of small pieces, 4″x2″x⅜″, and one large piece, 7″ long, 4½″ diameter, all of the same make, in the same pot. The result was that the small pieces were properly annealed, and had not lost any of their cutting or tempering properties, and the large piece came out as coarse grained as soft pig iron. It was unfit for use, and could be tempered only by a chemical bath. Query: Was the large piece overheated or not; and if it was, how could it have occurred, having been surrounded by the small pieces which were all right?

Regarding the breaking of twist drills in the center, the writer gave a machinist a new drill (twist), and in about five minutes afterwards was informed that it was broken in the center. My experience and observation is that seventy-five per cent. of them break in the same way, and I think that the twist or torsional strain has about as much to do with the breakage as the uneven temper. Another cause of breakage results from forcing a drill through the bottom of the hole, as the drill catches and is supported by the hole it has made, and will break above or

in the center. The old saying in a machine shop to "rush your roughing work and take time enough to do your finishing and fitting well" will hold good, I think, while feeding a twist drill through a hole.

I would like to ask, before closing, if some of the readers of your valuable journal can give any suggestions concerning lathe dogs. I want to order a new lot for shop use, but hesitate as to what to get to fill the bill, viz.: to be as handy as the bent tail dog, and as effective as the straight dog. Why would not a dog having two bent tails, with a set or holding screw half way between the tails, be a good thing where driving plates have two or more slots? QUERIST.

### Cast Iron Boiler Heads and Coroner's Juries.

*Editor American Machinist:*

In your issue dated July 9th is an article headed as above, in which the following statement occurs: "The coroner's jury was composed of experts known to be hostile to the Hartford Boiler Insurance Company, and their verdict specially censuring the Company, exhibits too plainly a prejudice that ought not to carry weight with fair-minded citizens."

The substance of the above quotation has been widely published in a great many papers, and should be corrected, because it is not true that the jury was hostile to the Company.

You admit in the same article that flat cast iron heads for boilers are dangerous, and the fact is known by the number of explosions occurring thereby. Flat cast iron heads are not allowed in Europe, and their dangers are explained in books which are in possession of the Company.

The boiler inspector of the Hartford Company testified at the coroner's inquest that he had no rule for flat cast iron heads, which ought to have been furnished him by the Company.

The wholesome effect of this just verdict is proven by the fact that the Hartford Company has now ordered their agents in Philadelphia not to insure any boiler with flat cast iron head above 30 inches diameter.

The writer of this was one of the jurymen, and if he is suspected of being hostile to the Hartford Boiler Insurance Company, he begs to assure the public that it is not true.

The writer has made the cause and prevention of steam-boiler explosions a special study, has written articles on the subject, and pointed out defects in steam boilers, which probably led to the erroneous suspicion that he is hostile to the Hartford Company. JOHN W. NYSTROM.

Philadelphia, Pa.

### Holding Power of Boiler Tubes.

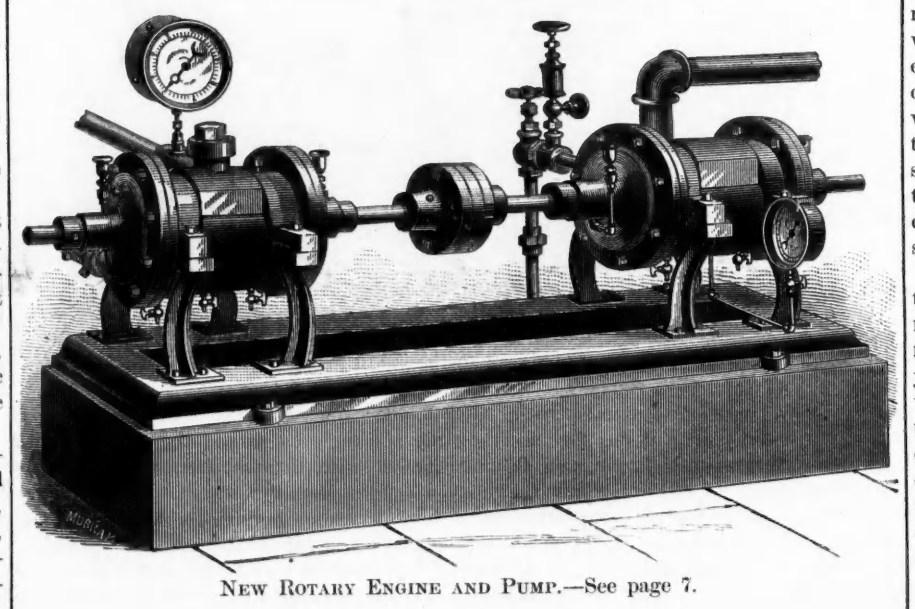
*Editor American Machinist:*

Your number of July 9th, 1881, gives the results of some interesting experiments made by the Hartford Boiler Insurance Company on the holding power of boiler tubes, a subject upon which very erroneous ideas prevail among engineers and boiler makers. The absolute holding power of boiler tubes and the relative value of various methods of securing boiler tubes were first thoroughly investigated in the year 1877 by the present Engineer-in-Chief of the Navy, Com. Wm. H. Shock, who made a series of tests with forty-eight brass tubes and eighteen iron tubes of different dimensions fixed in iron, steel, and copper tube plates, by the various methods employed in marine and locomotive engineering. An account of these experiments was first published in *Engineering*, September 14th, 1877, and they are fully described and illustrated in Com. Shock's book on "Steam Boilers," published by D. Van Nostrand, New York, 1880. I can give in the present article only a few of the highly interesting results of these experiments, and quote the following, viz.:

"The tubes secured by nuts only screwed on the outside of the plates, gave way by drawing the ends through the nuts without stripping or otherwise injuring the thread. When iron ferules were used in connection with the nuts, the holding power of the tubes was greatly increased."

EXPERIMENTS ON HOLDING POWER OF BOILER TUBES, BY CHIEF ENGINEER WM. H. SHOCK, U. S. N—JANUARY, 1877.

| Number of Experiment. | Outside diam. of end of tube where fracture took place. | Area of cross section of body of tube. | Thickness of tube-plate. | Strain in pounds—Mean result. | Method of Fastening. |
|---|---|---|---|---|---|
| (*a*) Iron Tubes. | ins. | sq. ins. | ins. | lbs. | |
| 1–3; 5–8 | 2⅝ | .981 | 7/16 | 22,650 | Expanded by Dudgeon tool, end riveted over. |
| 9–10 | 2⅝ | .981 | 7/16 | 22,150 | Expanded by Dudgeon tool, end partly riveted over. |
| 4 | 2⅝ | .981 | ⅜ | 25,525 | Expanded by Dudgeon tool, end riveted over. |
| 11–12 | 2⅝ | .981 | ⅜ | 29,675 | Expanded by Dudgeon tool, feruled, *not* riveted over. |
| 13–14 | 2⅝ | .981 | ⅜ | 13,050 | Simply expanded by Dudgeon tool. |
| (*b*) Brass Tubes. | | | | | |
| 5 | 2½ | .9 | ½ | 21,150 | Expanded by Dudgeon tool, end riveted over. |
| 21–22 | 2½ | .9 | ½ | 6,750 | Expanded by Dudgeon tool, end *not* riveted over. |
| 31–32 | 2½ | .9 | ¾ | 19,450 | Expanded by Dudgeon tool, end riveted over. |
| 43–44 | 2½ | .9 | ⅝ | 23,070 | Expanded by Dudgeon tool, end riveted over. |
| 3–4 | 2½ | .9 | ½ | 34,375 | Expanded by Dudgeon tool, end feruled and riveted over. |
| 8 | 2½ | .9 | ½ | 46,000 | Expanded by Dudgeon tool, end feruled, and riveted over. |
| 9–10 | 2½ | .9 | ⅝ | 37,650 | Expanded by Dudgeon tool, end feruled, and riveted over. |
| 23–24 | 2½ | .9 | ¾ | 28,310 | Expanded by Dudgeon tool, end feruled, *not* riveted over. |
| 1–2 | 2½ | .9 | ⅝ | 29,125 | Expanded by Prosser tool, feruled. |
| 6 | 2½ | .9 | ½ | 12,000 | Expanded by Prosser tool, *not* feruled. |
| 7 | 2½ | .9 | ½ | 27,800 | Expanded by Prosser tool, feruled. |
| 11–12 | 2½ | .9 | ⅝ | 25,850 | Expanded by Prosser tool, feruled. |



NEW ROTARY ENGINE AND PUMP.—See page 7.

"The lowest results were obtained in experiments Nos. 21 & 22 [with brass tubes], when the tubes were simply expanded by the Dudgeon tool in a ¾" plate without being beaded over or secured by ferules, the resistance being 7,650 pounds and 5,850 pounds respectively. It will be seen that even in this most unfavorable case, the holding power of the tube was greatly in excess of any strain which would be occasioned by the pressure of steam upon the portion of the tube plate, which any one tube would have to support in a boiler."

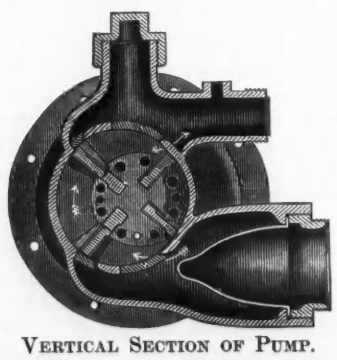
These results agree very closely with those obtained by the Hartford Boiler Insurance Company.

The following are some of the general conclusions drawn from the results of Mr. Shock's tests of brass tubes, viz.:

"(1) That the tubes fixed by the Dudgeon expander, and beaded over, have a considerably stronger hold of the tube plates than those fixed by the Prosser expander, particularly with thin tube plates. (2) That if the tubes are not beaded over, the hold afforded by the Dudgeon is less than that afforded by the Prosser system of fixing. (3) That with both expanders, the introduction of ferules adds very materially to the holding power of tubes. . . . (6) That the employment of nuts screwed on the tubes outside the tube plates is not of any service in increasing the holding power unless the tubes are feruled."

In the case of iron tubes, fracture took place almost invariably by breaking off, or cracking the ends which were riveted over; and as fracture took place in this manner with greatly different strains, it appears that iron tubes are apt to be injured by the process of riveting over their ends. The iron tubes simply expanded by the Dudgeon tool bore a considerably greater strain than the brass tubes secured by the same process.

In consequence of these experiments, the use of stay tubes secured by nuts has been abandoned in boilers for United States naval



VERTICAL SECTION OF PUMP.

vessels carrying 80 pounds of steam. All tubes are simply expanded by the Dudgeon or Prosser tool, except some few tubes in the neighborhood of manhole plates and trussed flat surfaces, which have their ends riveted over. C. R. ROELKER.

Washington, D. C.

### Construction of T Squares.

*Editor American Machinist:*

The article by Prof. Sweet on "Mechanical Drawing," which appeared in your issue of July 16th, moves me to ease my mind on the subject of T squares.

I agree with him that those commonly kept by dealers are worthless, hence I construct mine in the following manner, viz.:

Make the head of the customary proportions in length and width, but a trifle more in thickness, by lowering the head over a small circular saw until the teeth are nearly through; cut a slot in the edge that comes next the drawing board. Insert the blade in the slot, and put a suitable bolt through the center of the head. The bolt, when screwed up, will produce sufficient friction to hold the blade firmly in position.

One of the advantages of T squares made in this manner is the ease with which they can be adjusted if they should be thrown out of their proper positions by a fall or otherwise.

The long slot permits the free use of triangles, and also the use of the square as a bevel. E. F. BENGLER.

Du Bois, Pa.

### A Guide for Hardening Steel.

*Editor American Machinist:*

If the proper heats for hardening carbon steels depend upon the percentages of carbon therein contained, it would not be difficult to construct a scale for those heats, provided the percentages were known.

Steel manufacturers are naturally desirous that the best possible results should be attained with their products, and that no accident or insufficient trial in any case should condemn it, when a knowledge of its composition might have effected a different result. Thus, while carbon is the hardening agent, different makers, with different material and processes, using the same percentage of carbon, would each produce steel of different properties, and requiring different treatment to secure the best results; yet it is doubtful if they would be so far unlike that the same degree of heat would not give practically the same results in hardening.

Instead of the consumer being compelled to experiment at a loss to himself until he finds the proper kind of steel, and the best means of tempering, etc., as suggested by your correspondent, it would seem as if it was the steelmaker's duty, as well as interest, to inform his customers what the compound of his steel is, at least as to the amount of carbon it contains, and this he could do by the use of a stamp giving the percentages of carbon in the various grades. It would save thousands of dollars to the steel workers.

This plan still entails upon the worker a knowledge of the proper heats for the different compounds, but if the maker chose to carry the plan still further, he could print upon his label, "Harden at ——— heat."

J. E. WILSON.

Bridgeport, Ct.

### How the Metric System Works Commercially.

*Editor American Machinist:*

Among my old papers I found the inclosed circular, which was published ten years ago, to advertise a business of manufacturing "ten-foot poles" and other measuring rods, in which I embarked, and which is somewhat of a curiosity in its way.*

I will call your attention to the "Notice" on the inside of the front cover, which I inserted, not because I was especially attached to the system then advocated, but in anticipation of what many persons then thought would soon be a great and wide-spread reformation.

The notice was as follows:

The superiority of the decimal system of notation, for all mathematical purposes, having been universally recognized and the system adopted, it is considered by scientific, practical men, to be absolutely indispensable that all weights and measures be made to conform to the same system, as has been done in France.

In view of the efforts now being made to accomplish this result, I would call the at-

* The circular referred to indicates a very creditable effort on the part of our correspondent to set forth the advantages of the metric system, and his confessed failure must be taken as evidence that the people did not welcome the innovation.

tention of practical men more especially to this reform, with the purpose in view of organizing business, and educating learners in accordance with its requirements.

To young men, particularly farmers and mechanics, who have the work of a lifetime before them, the knowledge of this system is a fortune itself.

To educators I would say, incorporate the knowledge of this system in your school books and earn for yourselves fame and money, by leading in this reform.

My own ideas of the decimal system accord with the views set forth by Mr. Coleman Sellers, in his able paper on the subject, which was read at a meeting of the A. S. of M. E., but in anticipation of a demand, and for the purpose of "showing what I advertised," I made one rod each, of 1 meter, 2 meters, and 3 meters in length respectively, and how many metrical rods do you think I sold? Ans. 0; and I received the same number of inquiries for them, although I sold many rods which were marked with divisions of 1 foot, and sub-divided decimally.

I send you this bit of experience for the benefit of the advocates of the adoption of the metrical system.

While writing of the decimal system, I will mention another practical attempt at its adoption, of which I learned a short time since. I was in one of the leading machine shops at Newark, N. J., where their reamers, mandrels, etc., are measured, and the variations in the sizes made by *hundredths of a foot*, and I was informed that other establishments in that city used the same standard, and had done so for a long time.

Can any of your correspondents inform your readers if such a standard is generally used in any section of the country?

Bennington, Vt. OLIN SCOTT.

## New Rotary Engine and Pump.

While rotary engines for ordinary purposes of furnishing power have never made much progress in popular favor (owing to causes familiar to most of our readers), some of them have come into extended use for certain purposes, such as for hoisting and for pumping water. We illustrate on the opposite page a new rotary engine and pump, which has been in experimental use for nearly six months, and which has peculiarities deserving the attention of engineers. Engines of this kind work equally well in either direction, and therefore can easily be made reversible. They are also designed to be compounded, and, it is claimed, can use steam at any desired degree of expansion. The pump can also be used as a water motor, also as a water meter. The engine has been used as an air compressor, and as an air pump.

In principle all of these machines are alike, but as each machine is designed specially for that class of work for which it is intended, in some of the details of construction in some of the parts there is a difference which we will refer to.

The working parts consist of a drum, to each end of which there is accurately fitted and firmly secured a drum cap. Each drum cap is recessed for the reception of an end of the drum, and also for the reception of the arms of a packing ring, and for the ends of vanes, which travel between and in contact with said arms. This packing ring is fitted to the periphery of the drum cap. The arms of said ring project inwardly, and are in contact with the sides of the recesses in the drum cap, and the ends of said arms are in contact with the periphery of the drum. Each packing ring has four pairs of arms, and the inner faces of each pair of arms is in line with four vane races or recesses which are in the drum. Each race in the drum has a recess in one side. This recess acts in connection with a corresponding recess in the vane which travels therein. The vanes are so recessed that only such portions as travel between the arms of the packing rings, and, as is desirable, should form alternately a close connection with the races in the drum, are subject to contact with said drum. Each of the vane races in the drum is brought into connection with its opposite race by means of two holes; into each of these holes is fitted a cylindrical tube, solid or plugged in the center. In each end of each of these tubes there are springs which project beyond the ends of the tubes. These springs bear on the vanes and keep them in contact with the inner periphery of the cylinder. The cylindrical tubes and springs move reciprocally with the vanes. Leakage between the periphery of the drum cap and the packing ring is prevented by a split metallic ring which is ground on to its seat on the drum cap and against the inner periphery of the packing ring. This split ring is kept on its seat by means of spiral springs inserted between it and a follower which is screwed on to the drum cap, and like means are used for the purpose of keeping each packing ring and its arms in contact with the face of the cylinder. The faces of the arms of the packing ring which are subject to contact with the cylinder, taper or diminish toward the center, for the purpose of proportioning their friction surfaces to the distance to be traveled under friction. Neither the drum nor drum caps touch any part of the cylinder, at any point in the revolution. Those portions of the cylinder in which the drum caps revolve are cylindrical, and true to a common center, while that portion which is between those cylindrical ends is formed to give such a reciprocal motion to the vanes as maintains an equal transmission of power at all points of the revolution. Such steam, air or water as may accumulate in the spaces between the drum caps and the cylinder covers, is prevented by means of a metallic packing (invented for and peculiar to these machines) from coming into contact with or escaping by way of the shafts. And should such accumulation be greater on one side, as much of it will pass through pressure balance openings in the drum into the corresponding space on the other side of the machine, as will be necessary to equalize the pressure on the outsides of both drum caps, and thus prevent the side thrust which would otherwise take place.

The recesses in the vanes and drum, before mentioned, are circulation channels, and are for the purpose of allowing a free circulation of liquids, fluids or gases in the vane races during the reciprocating movements of the vanes; and they also enable the friction surfaces to be proportional to the distance to be traveled under friction.

These machines have recently been brought out by the inventor, Edward Waldron, 137 Elm St., New York, where one of them is in operation.

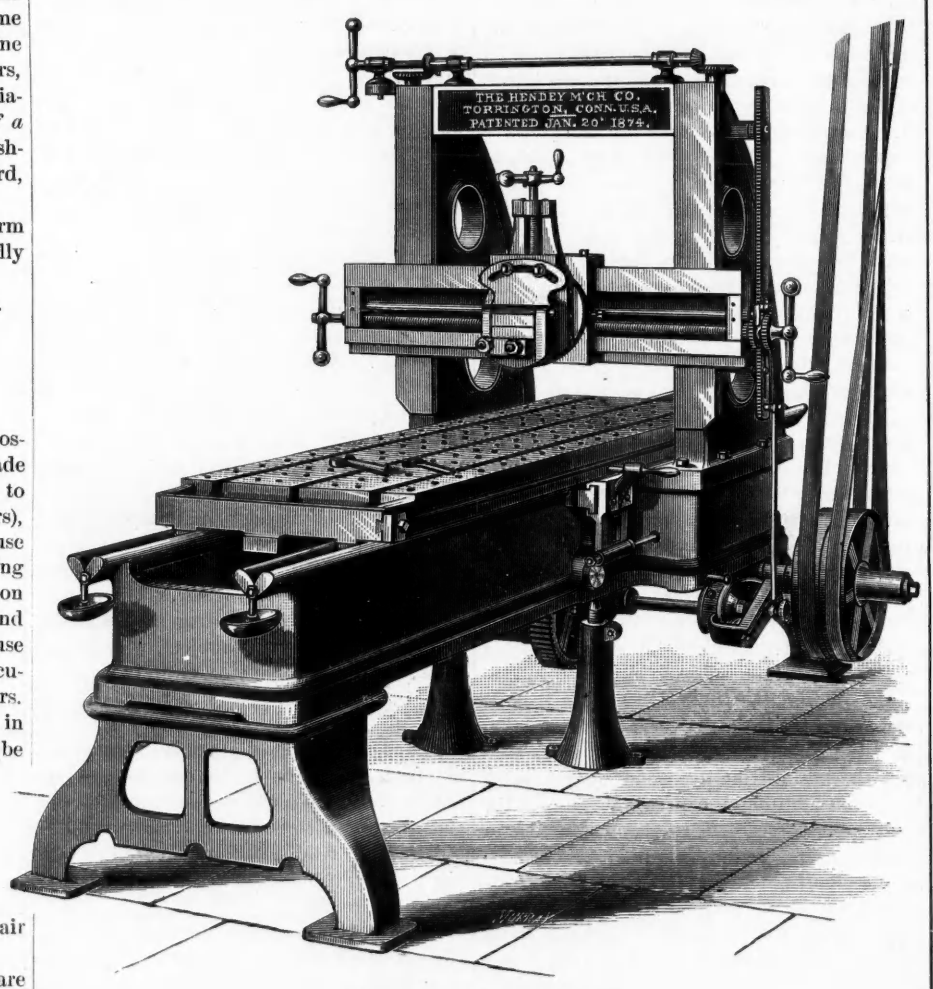
## Improved Iron Planer.

The accompanying engraving represents an improved friction planer, built by the Hendey Machine Company, of Torrington, Conn. This machine will plane 6 feet long, 24" wide and 24" high, and is strong and substantial in all its parts, its weight being 4,800 lbs.

In the manufacture of this planer the modern requirement of finishing all surfaces that wear in contact, by accurately scraping instead of grinding, is strictly attended to.

The gears and racks are cut to insure smooth working, while all nuts, wrenches, screws, etc., are case-hardened. The feed screws are of steel, square-threaded, and all feed motions—horizontal, vertical and angular—are automatic.

A fact sure to be appreciated by any man who runs one of these planers is that the holes in the table are all reamed to a definite size, making it possible to use pins that will fit; also, that the bolt slots are planed true and perfect. This planer has quick-return motion, and we are told will reverse inside of ¼". The belts on this planer are not required to shift on the pulleys, making, it is claimed, a great saving in belts, and insuring perfect accuracy of stroke.




IMPROVED IRON PLANER.

## The "Traveling Engineer."

A new office, at least, for the New York Central, has been created, that of "Traveling Engineer," an old runner, whose duty it is to travel about the line of the railroad by which he is employed, and keep an eye on the engineers and firemen and see that they are attending to their duties, and make reports to the main office. This gentleman comes and goes as he will, and sometimes turns up in most unexpected places, and if an engineer or fireman happens to be running a little too fast for the card, or has been careless with his engine, it is not soothing to his feelings to have this new official pop out of some place in full view and calmly inspect him. Such a person has been at work on the Erie for some time, and it is said to keep the men up to their work. The gentleman who has taken this duty on the Central was in town last week, and was making himself acquainted with the men along the line. He is said to come from the Harlem, and to be a capable engineer

The above we clip from the Syracuse *Evening Herald*. We have no doubt the plan is a good one, both for the company and for their men. While it is well for the former to look closely after the men in their employ, we believe that, as a class, railroad engineers and firemen are amongst the most efficient and trustworthy employes to be found anywhere. Our opinion is that they will not be found objecting to intelligent overlooking.

## Newly Incorporated Companies.

NEW YORK.

The Whitesboro Manufacturing Company, Limited, Whitesboro; Thos. Ellis, David Davis and Wm. C. Ellis, incorporators; Capital, $50,000. To manufacture and sell pails, brooms and furniture.

National Stove Company, New York; John B. Thomas, Thos. W. Haines and Nathan T. Madden, incorporators; Capital, $30,000. To manufacture and sell stoves, furnaces and heaters, and the appurtenances thereto.

Montgomery Palace Stock Car Company, New York; Rob't Garrett and Henry C. Turnbull, Jr., of Baltimore; Jas. Montgomery, of Chicago; and Geo. G. Haven, W. H. Ogden Hegeman, Chas. W. Rogers and S. A. Strong, of New York, trustees; Capital, $10,000,000. To manufacture, own, furnish, let, sell and maintain locomotive engines, cars, rolling stock and machinery, to be used or operated upon railroads.

The International Ice and Refrigerating Machine Company, New York; Leonard Forbes Beckwith, Etienne Gillett and Auguste J. Rossie, incorporators; Capital, $500,000. To manufacture and sell machinery, etc., for the production of artificial ice and refrigerating purposes.

Pearline Paper Manufacturing Company, New York and Brooklyn; Alexander McDonald, Lewis Basted and Edward T. Bradford, incorporators; Capital, $100,000. For the purpose of waxing and glossing all kinds of paper, by coating or sizing the same so as to render the paper water proof.

The Greene Knitting Company, Limited, Amsterdam; Henry E. Greene, Jane M. Greene, John R. Warwick, and others, incorporators; Capital, $100,000. To manufacture and sell knit goods and hosiery.

The Ithaca Bridge and Manufacturing Company, Ithaca; Edw'd G Westcott, Daniel R. Kelly and Chas. Kellogg, incorporators; Capital, $200,000. For the manufacture of bridges, structures, and other articles or manufactures from iron or other materials.

W. C. Vosburgh Manufacturing Company, Limited, Brooklyn; Wm. Duryea, Wright Duryea, John Nix, and others, incorporators; Capital, $150,000. To manufacture and sell gas and steam fixtures, and fittings of every description.

Central Refining Company, Limited, New York; P. D. Barker, Wm. Gaston, John J. Barker, A. B. Thacher, and Wm. H. Green, incorporators. To mine, purchase, and refine crude petroleum and its products, and to manufacture and sell tin cans and other articles to be used in connection therewith.

Bates Automatic Elevator Company of New York; Chas. B. Messerole, Abel Denison, and J. Byron Foulke, incorporators; Capital, $200,000. To manufacture and sell automatic elevators and all machinery and implements necessary for or applicable to the making of said machines.

The Brush Electric Light Company of Rochester; George E. Jennings, George C. Buell, Frederick Cook, and others, incorporators; Capital, $100,000. To manufacture electricity for light, heat and power, and to manufacture, buy and sell the various apparatus connected therewith.

The Leaycraft Pneumatic Company, New York; Edward McMurdy, James F. Casey, and Louis W. Frost, incorporators; Capital, $10,000,000. For the manufacture, construction, fitting up, selling, and renting of pneumatic tubes, pneumatic brooms, and all apparatus connected with and relating thereto.

New York Electric Motive Power Company, New York; Benj. H. Jessup, Frederick M. Parrett, Geo. C. McKelvey, Richard B. Fithian, and Lemuel B. Fithian, incorporators; Capital, $500,000. To manufacture and sell engines with full levered crank and gear attachments for use in producing electricity.

Manhattan Electric Power Company, New York; Charles C. Dodge, E. H. Potter, Robt. K. Boyle, John Newton, E. L. Lowe, and Edward A. Calahan, incorporators; Capital, $100,000. To manufacture and sell apparatus for producing and supplying electricity for electric lighting, electric engines, and for general telegraphic purposes.

MASSACHUSETTS.

Rotary Shuttle Sewing Machine Company, Foxborough; Wm. T. Cook, Prest., Benj. F. Boyden, 2d Treas.; Capital, $50,000. For the manufacture and sale of Sewing machines.

Munroe Felt and Paper Company, Boston; John R. Hall, Prest., Henry T. Hall, Treas.: Capital, $60,000. For the manufacture of felt paper and kindred fabrics.

PENNSYLVANIA.

The Pennsylvania Tube Works, Pittsburgh; Joshua Rhodes, J. J. Vandegrift, Wm. H. Latshaw, and others, incorporators; Capital, $800,000. To manufacture pipe and tubing.

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NEW YORK, JULY 30, 1881.

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The printed date on each wrapper shows the time to which the subscription is paid. We discontinue the paper in all cases when the time paid for has expired, unless renewed.

## The Machine Tool Industry.

In our first weekly issue (June 28th, 1879) we published a list of the machine tool builders of the United States, and took occasion to say, in the course of an editorial: "To properly carry on a general machine tool establishment requires not only the highest mechanical talent, but a very long purse. New tools must be brought out from time to time requiring new sets of expensive patterns, and perhaps costly experiments before they are made to work satisfactorily. The industry has suffered most severely by the depression in business, but is now gradually recovering a healthy condition. Many firms have been driven to seek other business, and some who have kept on have shrunk up in volume considerably." The power of an industry to recuperate after suffering the most discouraging reverses is nowhere better exemplified than in the manufacture of machine tools. At the time referred to there were forty-three concerns regularly in the business, five of whom have since abandoned it to devote their efforts to other mechanical work. Since then, however, other new concerns have started, until now there are some fifty establishments in this country before the public as builders of machine tools (most of whose addresses may be found in the columns of the AMERICAN MACHINIST), with four or five more preparing to enter the lists as active competitors. Many of the older establishments have materially increased their capacity within the past two years, and yet, with all the increased facilities for supply, the demand has advanced more rapidly than the ability to meet it. Almost all the shops are behind their orders, and those wishing to secure engine lathes, upright drills or planers are obliged to place their orders several weeks or frequently several months ahead.

The stimulus to increase production has never been greater, some shops running twelve, fifteen, and in one or two instances even twenty-four hours a day. An especially favorable feature of the trade is that poorly made and poorly designed tools are becoming rare exceptions, whereas while business was depressed such tools were very common in the market. Prices of machine tools, while they have advanced considerably, have not reached excessive figures. In some instances, however, parties are willing to pay extra prices for early delivery. The question is being asked by some conservatives: Will not the business be overdone by providing so much additional capacity to supply the market? There seem to be no grounds for apprehension, so long as the users of machine tools increase in a greater ratio than the manufacturers of the same, or even in as great a ratio. Machine shops are multiplying very rapidly for all classes of work, and machine tools are at the foundation of almost everything made by machinery.

## What Shall I Study?

We are from time to time in receipt of letters from young men, asking, "What shall I study to become a mechanical engineer?" We would willingly reply personally to all such inquiries if we were persuaded it would answer any useful purpose to do so. Our entire sympathies are with every young man who asks that question; and any service would be cheerfully rendered. We doubt, however, were we to reply to each interrogatory of this character, by marking out a course of study and naming the text books in their progressive order, if it would be of any practical utility whatever. A close personal acquaintance, and a knowledge of the personal habits, present proficiency, and, above all, the earnestness of the writer might possibly enable us to offer some advice; but we doubt even then if it would be of much use.

The subject that these young men propose to study is a comprehensive one. So much is, or may be, included in the title that there is no reasonable probability of learning anything of the physical sciences that will come amiss.

At the risk of repeating what may have been said before, we offer a few general suggestions to every young man who has asked this question, or who has felt inclined to ask it.

First, study your wants. You must have formed some idea of what a mechanical engineer ought to know; otherwise how do you know you want to be one? You have no doubt you will need to know a great deal of mechanics. You have no doubt you must understand mechanical drawing, and push along with mathematics. You expect you could make use of a knowledge of electricity, chemistry, and other branches of the sciences. If you have such doubts you don't want to be a mechanical engineer; that is, you don't know that you do. After you have carefully considered your wants you will find that the main thing is to study—anything—everything, in the line of your wants. Fortunately, every subject you study will be suggestive of others; so suggestive as to leave no inclination to ask what shall follow.

After all, you can learn but little of mechanical engineering from books. A knowledge of all the literature upon this subject in the world will not make you a mechanical engineer, any more than the fact that you are an expert penman will demonstrate your ability to write a first-class business letter. Your every-day observation and personal experience must furnish the burden of your capital.

Do not interpret this statement as in any way discountenancing book knowledge. Our advice is, get all such knowledge you can, but don't imagine that book knowledge alone will ever make you a mechanical engineer, except in name.

In the matter of personal observation, such as of the construction going on in the shops where you are employed, it is sometimes urged that faulty examples are frequently presented. We doubt if this is not all the better. You have the opportunity to demonstrate to yourself how, and where, and why the fault is. Nine-tenths of the useful knowledge of an engineer is in knowing what to avoid.

A somewhat famous philosopher once said: "The way to resume (specie payments) is to resume." The way to study mechanical engineering is to study. There may have been instances of young men honestly intent on studying this subject, who turned their energies in directions entirely unprofitable, but we never saw an example of the kind.

It was not proposed when we started this to offer a suggestion in the way of any particular book. We will make one, however. Get a copy of some good work on natural philosophy; read it through carefully and study the subjects that suggest themselves to you in the reading.

After acquiring some elementary knowledge of these subjects, useful books treating upon each of them can be obtained as you progress.

## Finances and Mechanics.

Our attention has just been called to a singular coincidence, which does not appear to have been intentional. The American Society of Mechanical Engineers holds a meeting at Altoona, Pa. (a summer resort), on the 10th, 11th and 12th of August, and the American Bankers' Association holds a meeting at Niagara Falls (also a summer resort) on the same three days. A number of papers will be read and discussed at both meetings. We have not been able to detect the particular relations between the business affairs in which the two societies are interested.

Perhaps some occult sympathetic influence exists between mechanical engineering and financial engineering which has prompted both societies to pitch upon the same date for meeting. The philosopher who can trace this influence may be able to explain the relation between rates per cent. and ratios of expansion (of steam), between mortgages and mechanism, discounts and dynamics, coupon clipping and calorimeter calculations, standard gauges and standard gold, or steam boilers and stock boards. Mechanical engineering, however, cannot safely be divested of its essential financial features. It is often owing to a deficiency in financial management that enterprises, well conducted in a mechanical sense, are suffered to decline, and eventually to go to the wall. In fact, some knowledge of financial matters is indispensable to the successful management of any kind of business. When a concern starts to build machinery, for instance, it should be regarded as a necessity to have one of its members a capable financial manager, as well as to have one of them a competent designer and shop superintendent. True, the capable mechanical engineer may also prove a highly successful financial manager; but of the many instances that have come under our observation this has been the exception rather than the rule.

## Scientific Boiler Explosions.

Considerable energy has been expended at one time and another in devising and putting into execution plans for exploding boilers, it being claimed by some that there has been but one case of genuine success in all the trials made. We have a plan to suggest, by no means new, but which may have been overlooked, just as other things common are sometimes passed by. It is this: Hire the cheapest available "engineer;" if he gets "about half seas over" occasionally when on duty, all the better; load him down with as many other duties as possible, and don't invest a cent for repairs or inspection. The result may not be scientifically all that is wanted, but there is a fair probability of such a "letting go" as will answer all practical purposes.

We shall be both pleased and surprised to hear of the ultimate failure of this plan from any one trying it faithfully.

## Profitable and Unprofitable Apprentices.

While we were talking with a foreman in a large machine shop some time ago, a bright, intelligent apprentice boy brought a piece of lathe work for inspection. The foreman looked it over, commended the boy for his progress and proficiency, and pointed out where he could make some improvements in another job of the kind. The boy went away with a radiant face, and it was easy to see that he was determined to make the improvements suggested on the next job. Then the foreman remarked: "These bright, active apprentice boys are really of more value in a shop than many of the regular journeymen. They are ambitious to learn and to excel, and, when properly encouraged, will get out as much work as some men who have been at the trade a dozen years. But if they are scolded for slight mistakes (as in some shops), and never commended, they become morose and rebellious, and probably give trouble. The same boy will prove a steady and profitable shop hand under one foreman, and a mischief maker under another. It is all owing to the kind of treatment they get."

We have noticed the course pursued with apprentices in many shops, and are convinced that the foreman here quoted was right.

We noticed some time ago in one of our exchanges — have forgotten the name and date—a bit of what purported to be original advice, adapted to the season. It was this: KEEP COOL. This advice was probably directed to those who are not troubled with a superabundance of work, and could just as well lie in the shade six or seven hours a day as not. It is very difficult for a busy man to keep cool during these hot days, but almost anybody can get cooled after the work is done.

## Literary Notes.

We are in receipt of a pamphlet of "Papers read before the Pi Eta Society," Rensselaer Polytechnic Institute, Troy, N. Y., edited by the Committee on Publication.

The list of papers is as follows:

"The Camber of Bridges," by Thomas M. Cleemann, C. E.; "The Inter-Oceanic Canal," by W. E. Dauchy, C. E.; "Bridge Pins; their Sizes and Bearings," by J. A. L. Waddell, C. E.; "Rational Fractions," by Adolfo E. Besosa, C. E.; "Note on Gor-

don's Formula for Long Columns," by Wm. H. Burr, C. E.; "The Size of the Angle Block in a Howe-Truss Bridge," by Thos. M. Cleemann, C. E.; "Discussion of Paper on 'Braced Iron Piers,'" by Wm. H. Burr, C. E.

These papers constitute a valuable addition to technical literature.

We have received from M. S. Humphreys, Chief of Bureau of Labor Statistics of Pennsylvania, a copy of his report for 1879–80. It is a volume of 474 pages, and it contains a fund of information on the coal, iron and steel, lumber, textile, petroleum, agricultural and miscellaneous industries of that State. The wages questions are treated at length.

## QUESTIONS & ANSWERS.

*Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common sense methods.*

(1) M. N. N., New York, writes, in substance: It would seem from your answer to question 4, date July 16, that in cutting screws without a backing belt, it is only necessary to bring the face plate and slide rest to the same position each time before locking the nut. Now, if while the face plate makes one revolution the screw makes the fraction of a revolution, the nut will not lock every time. For if the face plate be given one revolution beyond the correct position for locking the nut it [the nut] will not close on the screw, notwithstanding the mark on the face plate is in its proper position. Therefore, not only should the position of the face plate be taken into account, but also that of the gear on the screw? *A.* M. N. N. is correct in his reasoning. The nut and screw must go into gear each time, with the slide in the same position in reference to its travel, and with the spindle and screw in the same position in reference to their revolution. Since, however, to note the position of screw from a mark on the screw gear would compel the operator to go to the end of his lathe, it was thought best to determine the correct position of screw by the ability to lock the nut. Of course, if the position is not right the nut will not lock, which of itself suggests the remedy, viz., turn the spindle until it will lock *with the mark on the face plate in position noted.* We think the whole ground is covered by saying that our advice contemplated going into gear each time, under the same conditions as to lineal advance of slide and revolution of both spindle and screw; but while our plan contemplated the determination of the position of the screw by the ability to lock the nut with it, our correspondent proposes to determine its position by noting a point in the revolution of the screw gear. We have been thus explicit in order that our readers may have the benefit of our correspondent's views and experience.

(2) A. W., Brooklyn, N. Y., asks: 1. Is there a book published treating of all the details of modern cooperage? *A.* We are unable to learn of such a book. 2. Could you give me a clear idea of how barrels and kegs are set up? *A.* We think you will have to learn how to make barrels by practical experience with a cooper.

(3) C. S., Newark, N. J., describes a plan for carrying foul air from a rendering tank to the furnace of his boiler, which we cannot well reproduce, and asks if it will work? *A.* If there is a pressure at all times there will be no difficulty. If not, you can induce a current through the pipe by putting in a small steam jet. We do not know the size of your tank, etc., but should presume ¾″ pipe to be too small.

(4) W. W., Rockford, Ill., asks our opinion on three devices, amounting to radical changes in existing forms of machine tools. *A.* The subject is too grave a one to be passed upon from the data furnished.

(5) M. E. L., Freeport, Ill., writes to say he does not think the plan for cutting screws with one belt [given in answer to F. T. J., July 16] is always satisfactory. He gives his plan, which we publish for the benefit of our readers, and which is as follows: Take one cut across the work, and stop the lathe at the end of the cut. Mark the top of face plate, and also of lead-screw. Leave the nut locked, and run back by hand to where you want to start, and as much further as will bring the marks on the face plate and lead screw exactly in the position they were in when the lathe was stopped at the end of the cut. Mark the position of slide on the shears, and go on with another cut, stopping this [and each successive] cut at exactly the same place as the first one. Stop the lathe, unlock the nut, and run the slide back to the mark. Lock the nut, and proceed with another cut. This plan will not always pay. For instance, in cutting a thread on a piece 1″ long it might be necessary to run back 1½″ beyond the end of the piece before getting into position to start right. *A.* See reply to M. N. N. this week.

(6) W. F. M., Hazleton, Pa., asks: Can you tell me how to clean iron for nickel plating? *A.* Cleanse by immersing in a solution of sulphuric acid and water, if the metal is new. If old, use muriatic acid and water. Afterward scour with sand, and *cleanse thoroughly* with water.

(7) C. E. K., Waynesboro, Pa., asks: 1. How shall I temper milling cutters to keep them from springing? *A.* Heat evenly, and not too fast, and dip them squarely and quickly. If your cutters are not forged and worked with great care they will spring, however you harden. 2. How are twist drills tempered so uniformly? *A.* See answer in issue of Feb. 7, 1880.

## BUSINESS SPECIALS.

*50 cts. a line for each insertion under this head.*

Best Portable Forges. H. Crumlish, Buffalo, N. Y.

Dies, Punches and Special Tools, manufactured by H. H. Coles & Co., 446 N. 12th St., Philadelphia.

Foot Power Machinery, for workshop use, sent on trial if desired. W. F. & John Barnes, Rockford, Ill.

**Presses & Dies. Ferracute Mach. Co., Bridgeton, N.J.**

Steam Engines Indicated and Examined. Power Measured. W. H. Odell, P. O. Box 274, Yonkers, N.Y.

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Special inducements offered to clubs. "Extracts from Chordal's Letters" in book form, now ready. Cloth. 320 pages. Less than 5 copies, $1.50 by mail, each, postpaid. American Machinist Publishing Company, 96 Fulton Street, New York.

A New Treatise on Steam Engineering, Physical Properties of Permanent Gases and of Different Kinds of Vapor. By John W. Nystrom, C. E., 8vo., cloth. Price, $1.50, also A New Treatise on the Elements of Mechanics, Establishing Strict Precision in the Meaning of Dynamical Terms. By John W. Nystrom, C. E., 8vo., cloth, price. $2.00, Mailed by E. & F. N. Spon. 446 Broome St., New York City, on receipt of price.

"Monitor Binder" for the AMERICAN MACHINIST holds 52 weekly issues in good shape. Sent to any address by mail for one dollar. American Machinist Publishing Co., 96 Fulton St., New York.

## MANUFACTURES.

Sullivan & Rice, Albany, N. Y., have commenced the building of engines and boilers.

The Chicago and Eastern Illinois Railroad is building a new machine shop and round-house at Danville, Ill.

The foundry of the Harrisburg Car Works, burned recently, will be reconstructed on a larger and more improved scale.

The Denver and Rio Grande Railway Co. is making extensive additions to its shops at Denver, Col., 800 men are now employed.

Warner & Swasey have, since July 11, occupied their new shops in the manufacture of machine tools in Cleveland, O. They moved from Chicago.

Wheeler & Melick Company, Albany, N. Y., agricultural implement manufacturers, are building a large four-story building for the manufacture of portable steam engines.

The Empire Portable Forge Co., Cohoes, N. Y., have just placed their new "Western" hand blower upon the market, and already have a demand in excess of present supply. They are exporting many heavy forges to foreign countries.

A new locomotive with a "patent steam reverse" is being finished at Reading, Pa., for the Philadelphia and Reading Railroad. This, it is said, will be the first locomotive ever built in Reading with an attachment for reversing the engine by steam instead of by hand.

The following new Ohio companies have been incorporated: The Youngstown Glass Roofing Company; capital, $10,000. The Queen City Forging Company, Cincinnati; capital, $50,000. The Champion Sewing Machine Company, of Hamilton: capital, $100,000.

Matthews' Steam Spring Packing Company is the name of a new firm, whose specialty is a new cylinder packing. They have just erected a shop in Norwood, Mass., for the manufacture of this and several other articles connected with railway supplies.—*Boston Journal of Commerce.*

Schleicher, Schumm & Co., 3045 Chestnut Street, Philadelphia, are building three Otto Gas Engines, each of 25 horse power, for a railway grain elevator, which proposes to keep each consignment of grain separate, and return each intact to its owner. Heretofore the largest gas engines made in this country have been about seven horse power.

The new firm of Lodge, Barker & Co., 602 West Fifth Street, Cincinnati, O., dates from January 1st of the present year. The members are all practical machinists. They are making a new engine lathe, 18 inch swing, with an automatic cross feed, which they assure us "is designed especially to meet the wants of the machinists of to-day." They also make a small turret lathe. The shop is full of orders.

The Troy Globe Valve Co., Troy, N. Y., is a new establishment which will shortly place a new globe valve upon the market. By revolving the cap on the bottom of their valve, and reversing the stem cover and gate a second valve is gained in the same case or body. By unscrewing the cap on the bottom, and putting it in one of the end sockets, an angle valve is obtained, and by removing the bottom cap altogether a three-way valve is produced.

The addition to the machinery department of the Jackson & Sharp Co., Wilmington, Del., consists of a two-story brick building, 96 by 106 ft., in which they have placed additional machinery of the most approved designs. Sixty new work-benches are in course of construction for the wood-workers alone in the second story of the addition, which will make room for 120 additional wood-workmen. They have put in a new 250 H. P. Corliss engine, and a pair of Babcock & Wilcox boilers. Car shops are also being added, 70x180 feet, and an addition to the blacksmiths' shop. The force will be increased to 900 hands.

The business outlook for the coming season is most flattering for the Whittier Machine Co., of Boston. They have unfilled orders for between 40 and 50 boilers of various dimensions, three of the largest (72″) being for the M. C. M. A. Exhibition Building. Six of same size, all steel, for the Victoria Mills of Newburyport. The capacity of their new and enlarged boiler shop is found to be none too great for their already increased business. They have lately shipped one boiler and several large water tanks, and other machinery to be used on the Sonora R. R. running into Mexico, also a large boiler to Atlanta, Ga., and elevator to Charleston, S. C. They have orders for about twenty elevators, several being for the N. Y. & N. E. R. R. Dock and Elevator Co.'s improvement of South Boston Flats.

## Newly Incorporated Companies.

NEW JERSEY.

International Life Raft Manufacturing Company, Camden; John D. Nevins, John G. Beasley, Walter K. Bocock, and others, incorporators; Capital, $50,000. To manufacture and sell life rafts.

American Spring Motor Company, Camden; Edward F. Lyon, William H. Bagley, George W. Fitts, and others, incorporators; Capital, $1,000,000. To manufacture and sell spring motors, and the licensing of others to manufacture under letters patent to Gilbert Underhill for the improvement of spring motors.

New York and Santa Fe Construction Company, Jersey City; Henry T. McCunn, Jadoc Staab and John W. Harman, incorporators; Capital, $250,000. To build and construct railroads or other works and improvements in the United States.

Durant Manufacturing Company, Newark; Horatio W. Durant, James E. Murphy, John H. Perry, and others, incorporators: Capital, $200,000. For the purchasing, making, using and selling of buckles having a reversed tongue, and the manufacture and sale of saddlery hardware and carriage trimmings.

The A. Hall Terra Cotta Company, Perth Amboy; Alfred Hall, Eber H. Hall and Robert W. Taylor, incorporators; Capital, $100,000. To manufacture terra cotta, buff and fire brick.

Chicago Underground Electric Company, Camden, N. J., and Chicago, Ill.; Frank R. Walton, Restore B. Lamb, and others, incorporators; Capital, $1,000,000. To purchase and acquire the exclusive right to operate an improvement in underground conduits for telegraph conductors, &c.

The Salem Transportation Company, Salem, N. J.; John V. Craven, Peter Peppler, and Thomas J. Craven, incorporators; Capital, $20,000. To transport, by water, passengers, goods, wares, &c. and to carry on a towage business on the Delaware bay and river, also the Chesapeake canal.

Florida Construction Company, Jersey City, N. J., and New York City; Allan McCulloh, William W. Green, Wm. M. Barnum, and others, incorporators; Capital, $2,500,000. To build, construct railroads, or other improvements in the State of Florida and other States.

Union Improvement Company, Jersey City, Thomas F. Wentworth, A. Duprat, and Wm. W. Green, incorporators; Capital, $10,000,000. To build, construct, equip, and operate railroads, and other improvements.

Pacific Construction Company, Jersey City; Alexander McDavell. James H. Ledlie, and others, incorporators; Capital, $100,000. To build vessels, wharves, docks, elevators, piers, and railroads for the Santa Rosa and Sonoma Railroad Company of California.

ILLINOIS.

The Franklin Mills Company, Chicago; Wallace Warren, Frank E. Taylor and C. D. Sherman, incorporators; Capital, $50,000. To manufacture flour or any other food productions from grain or cereals.

American Cable Company, Chicago; George E. Bonell, Geo. B. Swift and John M. Smyth, incorporators; Capital, $150,000. For the manufacture and laying of wire cable to be used for telegraph, telephone and other purposes.

Chicago Telegraph Supply Company, Chicago; John N. Le Moyne, Rosswell B. Bacon and Alexander J. R. Feigo; Capital, $15,000. For the manufacture, purchase and sale of all telegraph and telephonic goods, and other electrical apparatus.

Castle Hay and Grain Loader Machine Manufacturing Company, Chicago; S. B. Castle, A. C. Messenger and H. H. Martindale, incorporators; Capital, $250,000. To manufacture, sell and buy any agricultural machines.

Parker's Manufacturing Company of Chicago; W. L. Parker, F. W. Parker and C. S. Burton, incorporators; Capital, $75,000. For the manufacture and sale of steam fitters' supplies, and other light metal machinery.

NEW YORK.

The Burden Iron Company, Troy; James A. Burden, I. Townsend Burden and Jno. L. Arts, incorporators; Capital, $2,000,000. To manufacture and sell iron and steel, and the various articles of commerce made from iron and steel.

New York Smelting and Manufacturing Company, No. 8 Warren Street, New York; Geo. A. Mercer, Sam'l J. Harrison and Wm. G. Morrison, incorporators; Capital, $250,000. To smelt ores of all kinds and refine metals, and manufacture furnaces in the State of New York, and elsewhere within the United States.

Coralline Jewelry and Novelty Company, Schenectady, N. Y.; Jno. K. Myers, Edw'd B. Powell, Wm. H. Halsey, and others, incorporators; Capital, $100,000. To manufacture and sell jewelry and other fancy goods from coralline.

The Staten Island North and South Shore Railroad Company; Thomas Chute, W. K. Soutter, E. L. Ridgway, M. C. Myers, A. C. Tunnison, C. Delafield, Rufus S. King, Chas. W. Adams, G. P. Wright, Jas. L. Curtis, N. Van Pelt, Richard La Tourette, C. C. Jones; Capital, $200,000. To construct, maintain and operate a railroad commencing at Elm Park, Northfield, Richmond County, Staten Island, running thence southerly by Granite Village, Bull's Head, New Springville and Richmond, terminating on Southerly Shore of Staten Island near New Dorp Land, in town of Southfield.

The National Extension Ladder and Fire Escape Company, New York; Eben S. Allen, Theo. F. Hascall, and F. W. Hofele, incorporators; Capital, $100,000. To manufacture, use, and sell extension ladders and apparatus for reaching high elevations.

Utica Furniture Company, Limited, Utica, N. Y., Peter Vidvard, A. Sickeryer, Ferdinand Snyder, and others, incorporators; Capital, $30,000. To manufacture and sell furniture.

The American Galvanic Company, New York; Daniel P. Bible, George W. Bible, and Martha E. Bible, incorporators; Capital, $50,000. To manufacture and sell galvanic electro batteries, electric and magnetic appliances and apparatuses.

Mutual Oil Company, New York; Chas. E. Orvis, John H. Herbert and Alfred Taylor, incorporators; Capital, $350,000. To mine and transport petroleum; to purchase, build and maintain tanks, storage and refining facilities, and all necessary and proper machinery and appliances for the transaction of the above business.

The New York and Cuba Mail Steamship Company, New York; John Roach, James E. Ward, James D. Fish, John S. Beecher, Henry P. Booth, Geo. E. Weed, and Wm. H. F. Hughes, incorporators; Capital, $2,000,000. To build for its own use, equip, furnish, fit, purchase, charter, navigate, and own vessels to be propelled by steam or other motive power, for use upon waters navigable by ocean steamers, for transportation of passengers, freight, and mails.

United States Mineral Wool Company, New York, Wallace C. Andrews, R. D'a Parrott, Cassius C. Peck, R. E. Rockwell, and James W. Hawes, incorporators; Capital, $300,000. To manufacture and sell mineral wool, and especially such manufacture from the slag or cinder of blast furnaces.

The H. W. Johns Manufacturing Company, New York; Henry W. Johns, Richard J. Dodge, Junius Gridley, Andrew G. Coffin, C. H. Luddington, Daniel B. Halsted and Robert J. Hunter, incorporators; Capital, $150,000. To manufacture and sell roofing, boiler felting, paints, &c., composed in part of asbestos.

The Carpet Sewing Machine Company, New York; James McMiler, M. Rosenshline, and Albert Boulter, incorporators; Capital, $250,000. To manufacture, use, and sell carpet sewing machines.

The American Iron Company, New York; Thos. M. Bissett, Anthony T. Bissett, John C. Lefferts, and Albert Ferguson, incorporators; Capital, $100,000. To manufacture and sell galvanized iron, sheet and metal roofing and ceilings, metallic shingles and iron articles generally.

American Laundry Machinery Company, New York; H. A. Wright, A. E. Rollen, and Franklin Everhart, incorporators; Capital, $10,000. To manufacture and sell laundry machinery and supplies.

The East River and Connecticut Railway Company; Wm. F. Van Pelt, Ernest Hall, Clarence L. Westcott, Chas. B. Hall, J. Thomas Stearns, H. E. Gawtry, Philip Allen, Samuel J. Young, P. Gardner, W. S. Hoyt, Lewis M. Brown, Frank G. Brown, and George D. Davis, Jr., directors; Capital, $500,000. To construct, maintain, and operate a railroad, commencing at or near Port Morris, on what was late the Westchester side of Long Island Sound, or Harlem River, via New Rochelle and Port Chester, forming a connection with the Ridgefield and N. Y. R. R. Co., or any other railroad line, with a branch road from Pelham via White Plains to Hall's Corners, connecting with the New York and Boston Railroad; also a branch road from the main line to a point at or near Fort Schuyler, Long Island Sound. Length of road about thirty-two miles.

## Machinists' and Engineers' Supplies.

NEW YORK, July 14, 1881.

Business is good in spots. Some houses are full of orders, and others quite dull. The warm weather has a rather languid effect on the trade. Manufacturers, as a rule, are kept very busy. T. R. Almond, 84 Pearl St., Brooklyn, N. Y., has issued prices of the Almond Chuck, as follows: ⅛ to 0, $102 a doz.; 5-16ths to 0, $66 a doz.; 3-16ths to 0, $60 a doz.; with ten per cent. advance on all orders for less than one doz. James D. Foot, 101 Chambers St., New York, has issued a price list of geared scroll, lever scroll, independent jaw and hand and lever chucks.

We are requested to state the mamufacturers of machine screws did not agree upon a uniform discount when the list was changed.

The Davis Globe Valve, just brought out by the Troy Globe Valve Co., Troy, N. Y., is virtually two globe valves in one. When one seat is worn or defaced beyond repair by unscrewing the cap on the bottom of the case, and reversing the stem cover and grate, an entirely new valve is produced. These valves are sold at about 10 per cent. advance on ordinary valves. C. L. Wright, 104 Duane St., is New York agent.

## Iron and Metal Review.

NEW YORK, July 14, 1881.

Pig iron continues dull and depressed. Quotations remain: No. 1 X Foundry, $23.50 to $24; No. 2 $21.50 to $22; Grey Forge, $20. Rails sell at former prices: No. 1 Wrought Scrap, from yard, $28 to $29. Manufactured iron from store: basis of 2.5c. for refined. Ingot Copper sells at 16c.; Straits and Australian tin 20⅛c. to 20⅜c; Billiton and common English tin 21c. Pig Lead is held at 4¼c. for common, and 4⅝c. for refined. Western Spelter 5c.; Sheet Zinc, 6⅞c.; and Antimony, 14c. to 14¼c

## WANTED

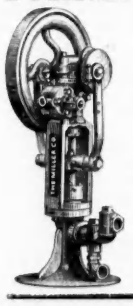
Wanted.—Man of experience to take charge of Tool room in machine tool shop employing 250 men. Address, stating experience, terms, &c., David W. Pond, Worcester, Mass.

Two or three young men of strong mechanical tastes to learn light mechanical business. Address, stating age etc., BOX 8, AMERICAN MACHINIST.

Wanted.—A young Swede, graduated from Technical High School and who has some practical experience, desires a position as draughtsman. Address, P., Fitchburg, Mass., Box 301.

The inventor of the Waldron Rotaries (the only *good* and *durable* rotaries which have ever been invented) wants capital for the purpose of manufacturing and placing these machines on the market. Is open to an arrangement with one or more capitalists, or would form a company. For illustrated description of these rotaries, see AMERICAN MACHINIST of July 30th, 1881. They can be seen in operation and tested at 137 Elm St., (near Grand). Edward Waldron, 137 Elm St., New York.


TORRENT STEAM PUMP.



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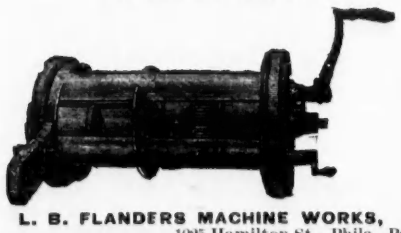

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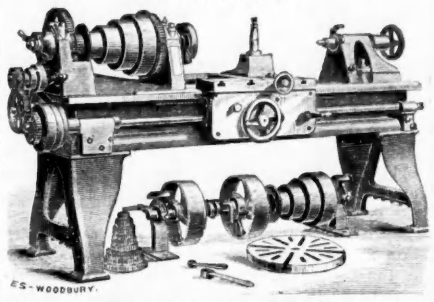

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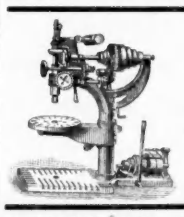

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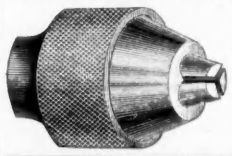

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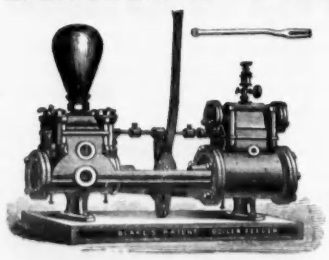

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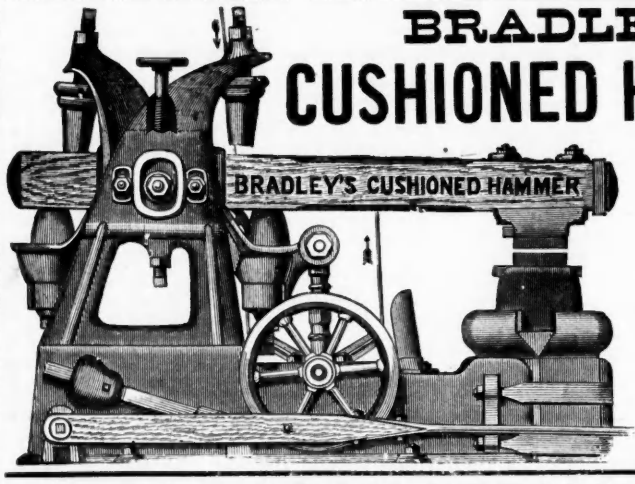


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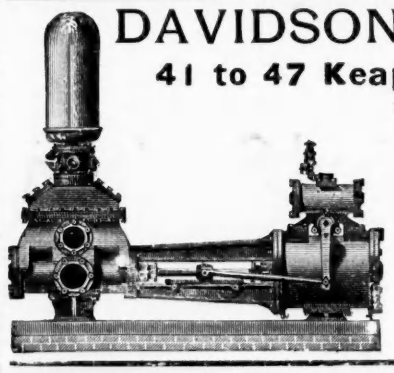

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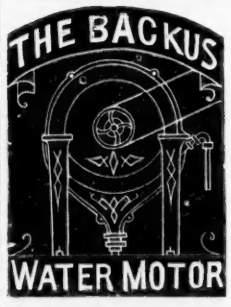

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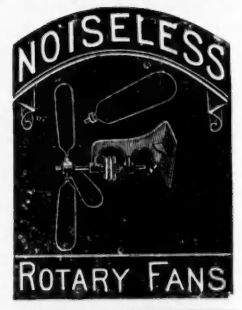

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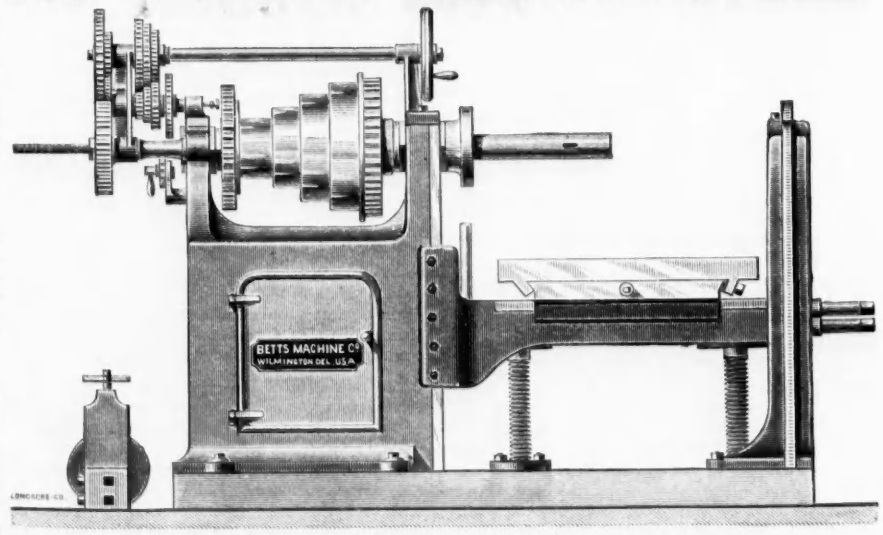


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